ÉTUDE SUR LA SANTÉ DANS LA RÉGION DE

Belledune

AREA HEALTH STUDY

Belledune • Petit-Rocher • Pointe-Verte

Appendix D -
Community Health Status Assessment Technical Report

Prepared for: Department of Health and Wellness, Government of New Brunswick

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Environmental
& Occupational Health+Plus

GOSS GILROY INC.
Management Consultants
Conseillers en gestion

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1.0 Introduction

This Technical Appendix presents and provides interpretations for the findings obtained from Community Health Status Assessment (CHSA) component of the Belledune Area Health Study. This Appendix provides a description of the detailed methodology and findings for the CHSA. This report is targeted to readers with a background in science, risk assessment or health status measures.

This report is structured with six main sections:

- **Section 1.0** – This introductory section contains a brief description of the study background, study rationale and approach, the study objectives, defining the study population, and an outline of data sources used for the study.
- **Section 2.0** – The second section provides an overview of the Demographic and Population Profiles of the study community.
- **Section 3.0** – This section contains an overview of analyses of reproductive outcomes and mortality based on vital statistics data sets for the period between 1989 and 2001 inclusive. These health indicators were compared for the Greater Belledune Area (GBA - primary study area), and Health Regions 5 & 6 with the New Brunswick standard population.
- **Section 4.0** – This section provides analyses of Cancer Incidence between1989 and 2001 for the GBA, Health Regions 5 & 6 and New Brunswick.
- **Section 5.0** – The results from the analyses of hospital separations between 1989 and 2001 for the GBA, Health Regions 5 & 6 and New Brunswick.
- **Section 6.0** – The final section contains the conclusions and recommendations for this component.

1.1 Background

The Greater Belledune Area (GBA), the study area, is located on the Baie des Chaleurs, in northern New Brunswick. The Study Area overlaps portions of two of New Brunswick's seven Health Regions. Region 5 extends from Campbellton to Belledune and Region 6 encompasses the Acadian Peninsula and the Chaleur region from Allardville, through Bathurst, to Pointe-Verte.

The Greater Belledune Area (GBA) has been home and/or neighbour to various industrial activities over the past four decades. The lead smelter, initially owned by Brunswick Mining and Smelting and now owned by Noranda Ltd., began operations in the mid-1960s. In addition to the lead smelter, there have been other industrial activities including a fertilizer plant, a battery recycling plant, a coal-fired electricity generating facility, a gypsum plant, and a sawmill. These industries have had various types and quantities of emissions over the past four decades.

In the fall of 2003, the Minister of Health and Wellness announced a health study for the residents of the Greater Belledune Area. Concerns had been raised with respect to the current health status of residents and the potential health impacts of local industry in general on the residents of the area. In late November, the Department of Health and Wellness (DHW) issued a Request for Qualifications (RFQ) . The submissions were evaluated, and a research team was chosen.

In early 2004, the Minister formed a Steering Committee for the study. This included the six mayors from the local areas (Belledune, Pointe-Verte, Petit Rocher, Nigadoo, Beresford and Bathurst), a representative from Department of Environment and Local Government (DELG), the local Medical Officer of Health, and three representatives from the Department of Health and Wellness (DHW).

In addition to the study team chosen through the RFQ process in late 2003, the DHW also conducted an open competition in the spring of 2004 to select a review team for the study. The review team reviewed the scientific work of the study team.

1.2 Objectives and research question

The purpose of this component is to address the following overall study objectives:

- *To describe and compare the health status of residents in the Greater Belledune Area with other residents living in New Brunswick; and,*
- *To provide recommendations on further research based on the results of this study.*

Based on the study objectives, the study team consulted with various stakeholder groups including community residents to determine what would be appropriate research question for this component of the overall study. This process resulted in the main research question for this component of:

- *How does the health status of residents compare with other regions? New Brunswick?*

1.3 Rationale

The health of the population is known to be a function of a number of determinants that makes people healthy or unhealthy. According to the landmark 1974 report A New Perspective on Health[1], health is influenced by four key factors. These factors include lifestyle, biology and genetics, healthcare, and the environment. While biology and genetics are largely pre-determined, social and environmental factors are more amenable to change. More recently, the Second Report of the Health of Canadians[2] added early childhood experience to the list and revised the wording of some of the other health determinants. These determinants of health are similar to those identified by the World Health Organization (WHO) including, social and economic; environment; physical environment, and a person's individual characteristics and behaviours[3].

WHO provides the following concrete examples of the influence of these determinants on health:

- ***Income and social status*** - higher income and social status are linked to better health. The greater the gap between the richest and poorest people, the greater the differences in health.

- ***Education*** – low education levels are linked with poor health, more stress and lower self-confidence.

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[1] A New Perspective on the Health of Canadians, Health and Welfare Canada, 1974

[2] Toward a Healthy Future, Second Report on the Health of Canadians, Prepared by the Federal, Provincial and Territorial Advisory Committee on Population Health for the Meeting of Ministers of Health, Charlottetown, P.E.I., September 1999

[3] Determinants of Health, World Health Organization, 2004

- ***Physical environment*** – safe water and clean air, healthy workplaces, safe houses, communities and roads all contribute to good health. Employment and working conditions – people in employment are healthier, particularly those who have more control over their working conditions
- ***Social support networks*** – greater support from families, friends and communities is linked to better health. Culture - customs and traditions, and the beliefs of the family and community all affect health.
- ***Genetics*** - inheritance plays a part in determining lifespan, healthiness and the likelihood of developing certain illnesses. Personal behaviour and coping skills – balanced eating, keeping active, smoking, drinking, and how we deal with life's stresses and challenges all affect health.
- ***Health services*** - access and use of services that prevent and treat disease influences health
- ***Gender*** - Men and women suffer from different types of diseases at different ages.

The WHO report also stated "*the context of people's lives determine their health, and so blaming individuals for having poor health or crediting them for good health is inappropriate. Individuals are unlikely to be able to directly control many of the determinants of health.*"[4]

While the relationship between the physical environment and health has been recognized by Canadian and global health authorities, it has also been raised as a concern by Canadian citizens including residents of the Greater Belledune area.

Many of the participants in the various community consultations held in the spring of 2004 identified specific health concerns that they would like to see addressed in the study. As illustrated in the results from the questionnaires (Figure 1.1), the top two health concerns were cancer and respiratory conditions. Many visitors to the open houses indicated that child development issues were of particular concern due to the presence of lead, and through observations they had made in the community. A number of other health conditions were identified by respondents on the questionnaires and through the open houses as areas to consider in the study including thyroid problems, specific cancers, and specific respiratory illnesses.

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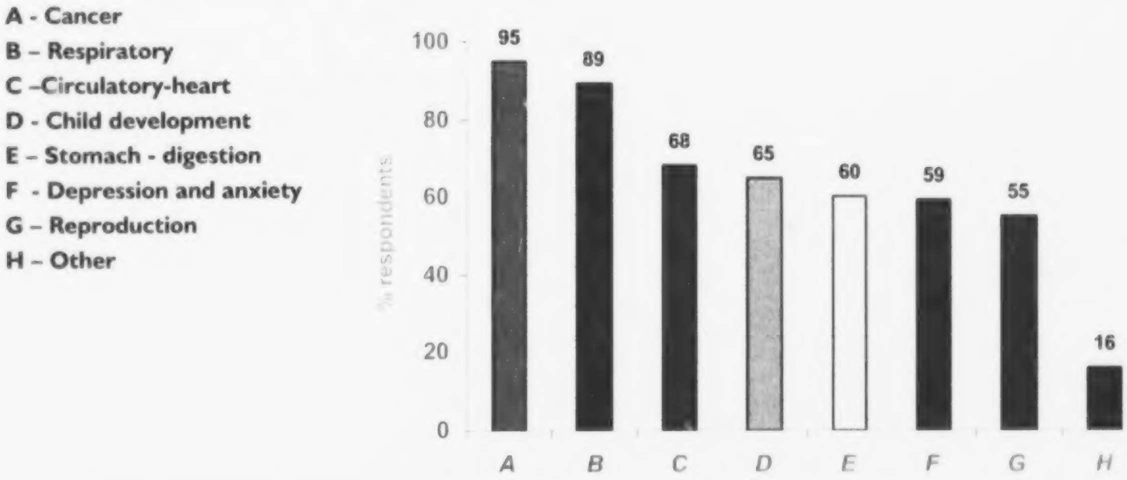
[4] Determinants of Health, World Health Organization, 2004

Figure 1.1: Specific areas of health concerns



Source: Questionnaire on Residents' Issues and Concerns (n=922)

1.4 Study approach

This study is a review of existing health and environment data. Data were derived from administrative records collected for various reasons other than environmental research. The choice of health outcomes for the CHSA was limited by data availability. Wherever possible, information from public consultations was also considered.

This study is thus an observational study which examines the frequency of health outcomes in several geographic areas, compares them to a common reference (New Brunswick population), and makes inferences about the potential contribution of health determinants on any differences found between the populations compared.

The geographic areas chosen for comparison reflect areas of different calculated exposures to the different contaminants in the environment. These differences in calculated exposures were determined by the review of environmental data. Thus, geographic area is a surrogate for level of exposure in the epidemiologic analysis that posits that differences in exposure may explain differences in relevant health outcomes, all other characteristics considered. This method is ecological in nature because calculated average exposures in any geographic area are attributed to the entire population of that area, and thus individual measures of exposure are not known. Ecologic studies are studies in which the unit of observation is a group, not separate individuals. Exposure and risk factors are known only at the group level, such as the average contaminant concentration in different areas. Disease occurrence is also only known at the group level, such as mortality from cancer in the same areas with measured levels of contaminant concentration. Ecologic studies may be used to generate hypotheses of an association between exposure and disease, but these studies cannot by themselves establish causation. This is because we do not know whether those individuals who died or suffered an illness in a particular geographic area under observation actually had a higher exposure than individuals who remained alive or did not experience the illness.

Within the context of epidemiologic studies, ecologic studies are useful to generate hypothesis about potential contributions to health by the environment or other determinants of health, and are subject to what is referred to as the ecologic fallacy.

This fallacy results from concluding that because an association exists between exposure and disease at the group level it therefore exists at the individual level. The cause of this fallacy is that we do not know the link between exposure and disease among individuals within each group. Furthermore, for diseases with long latency period (e.g., cancer), the initial exposure to the carcinogen may be different than the current of resident due to mobility. For example, we don't know the number of diseased persons who were exposed or not exposed in the high exposure group or in the low exposure group. The conclusions made here are therefore for the GBA population as a whole, not for individuals therein.

Individual measures of exposure in the form of a maximally exposed individual, or a child, or an average exposed individual are considered in the HHRA, as concepts for calculating risk, not in the CHSA. These calculations assist in making some inferences about the health impact of potential exposures to the contaminants under examination, and to make inferences as well about illness experience of the area residents as a whole.

1.5 Selection of health indicators

The initial steps the study team took in deciding which aspects of health status to examine under the CHSA were:

- To consult with GBA residents to determine which aspects of their health they were most concerned about ;
- To review the scientific literature to determine which health impacts could possibly be associated with the specific COPC selected for the HHRA component of the study; and,
- To review the available existing health status data for the GBA and NB to determine what health status variables could be addressed.

Of particular importance based on GBA residents' concerns was the incidence of cancer in the GBA. Residents also indicated that they were concerned about respiratory problems, circulatory problems, child development, gastro-intestinal problems, depression/anxiety, and reproductive problems. In addition, a number of residents mentioned that they were concerned with thyroid disease in their community.

A review of the scientific literature of health impacts related to exposure to COPC tended to support the specific areas of concern expressed by GBA residents during the consultations. A review of epidemiological studies that have attempted to link disease with COPC exposure indicated that the study team should attempt to study cancer incidence, child development issues, respiratory disease, diseases of the digestive system, diseases of the urinary system, diseases of the circulatory system, diseases of the endocrine system, and reproductive issues including birth defects.

The review of existing health status data for NB indicated that the only disease-specific registry available was for cancer. Vital statistics data captured relatively complete information with respect to births (live birth or stillbirth, birth weight, gestational age, birth defect, age of mother), and deaths (cause of death, age, sex) Hospital separation data captured the most "responsible diagnosis" (e.g., respiratory disease, circulatory system disease) for patients discharged from a hospital in NB. All of these data sources used the standardized International Classification of Diseases (ICD-9 and ICD-10) to code medical conditions. All data sources were also able to provide information on place of residence at the time of the event (e.g., cancer, death etc), so that the study team could determine rates for GBA residents and compare them with other areas of NB. The time period that was common to all health data sets was 1989-2001 inclusive. As a result, this 13-year time period was used for all sets of analyses.

For purposes of definition and clarification the specific ICD-9 or ICD-10 codes are provided for all health outcomes discussed in Sections 3 and 4 of Appendix DA (Vital Statistics and Cancer Incidence Sections).

One of the greatest limitations to this approach was the absence of any reliable population data on child development given the GBA residents' specific concerns, and its potential relationship to lead as a COPC. The study team reviewed the NB Early Childhood Initiatives data set, and it was determined that the data were not adequate for use in this type of study to describe population-level indicators of child development. The Early Childhood Initiative is a province-wide integrated initiative aimed at identifying children with special needs. All newborns in the province are screened using the *Public Health Priority Assessment* tool. This tool was designed to identify children with congenital or acquired health conditions, developmental problems or family problems. This tool does not use standardized diagnoses (e.g., ICD-9 or ICD-10) for any illness or disease reported. With the possible exception of birth data associated with this initiative, the associated clinics and services operate on a volunteer and referral basis only. As such, they are susceptible to biases in referral patterns and accessibility. While the data collected through this initiative may be adequate for the implementation of the activities and services under the initiative, it is the opinion of the study team that they should not be considered as representative of the population, and, as a result, should not be used to describe population-based disease rates or health conditions.

The absence of any childhood development data explains in part the study team's recommendation to carry out a pilot survey of children's blood lead levels in the potentially most impacted communities. This survey was conducted by the Department of Health and Wellness in the fall of 2004. As a result, the study team had access to biological measures of exposure for the purposes of this study (See Appendix E for summary results of this pilot survey).

1.6 Comparison populations

One of the challenges of environmental epidemiology is identifying populations at risk from exposure to environmental contaminants of concern. In this study, we define population at risk as those living in close proximity to the source of chemicals of potential concern. Specifically, we assume that those living in closest to the area of concern would be exposed to the highest concentration of putative agents while those living further way from the point source is exposed to a lower level of contaminants of concern. This assumption is tested by reviewing the environmental data which confirmed the use of the populations chosen for comparison. In this study, we have two study populations:

Greater Belledune Area (GBA) – this includes the villages of Belledune, Pointe-Verte, and Petit Rocher (see Figure 1.2) and is the actual population of interest for the study; and,

Health Regions 5&6 (HR 5&6) – this includes the population of the Regions in both 5 & 6 combined (see Figure 1.3).

Figure 1.2: Map of study area

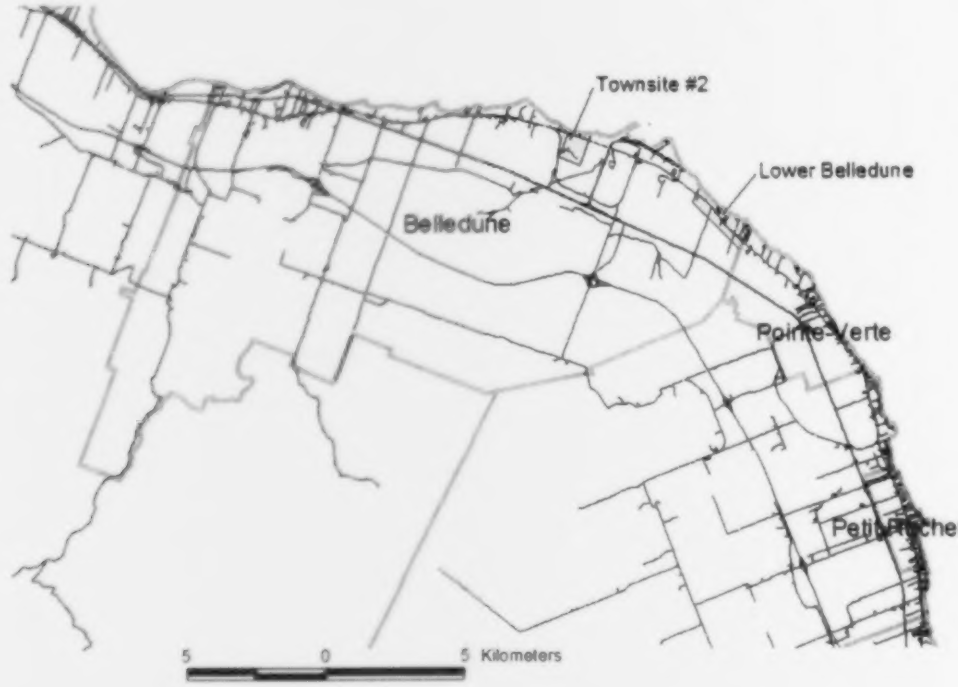
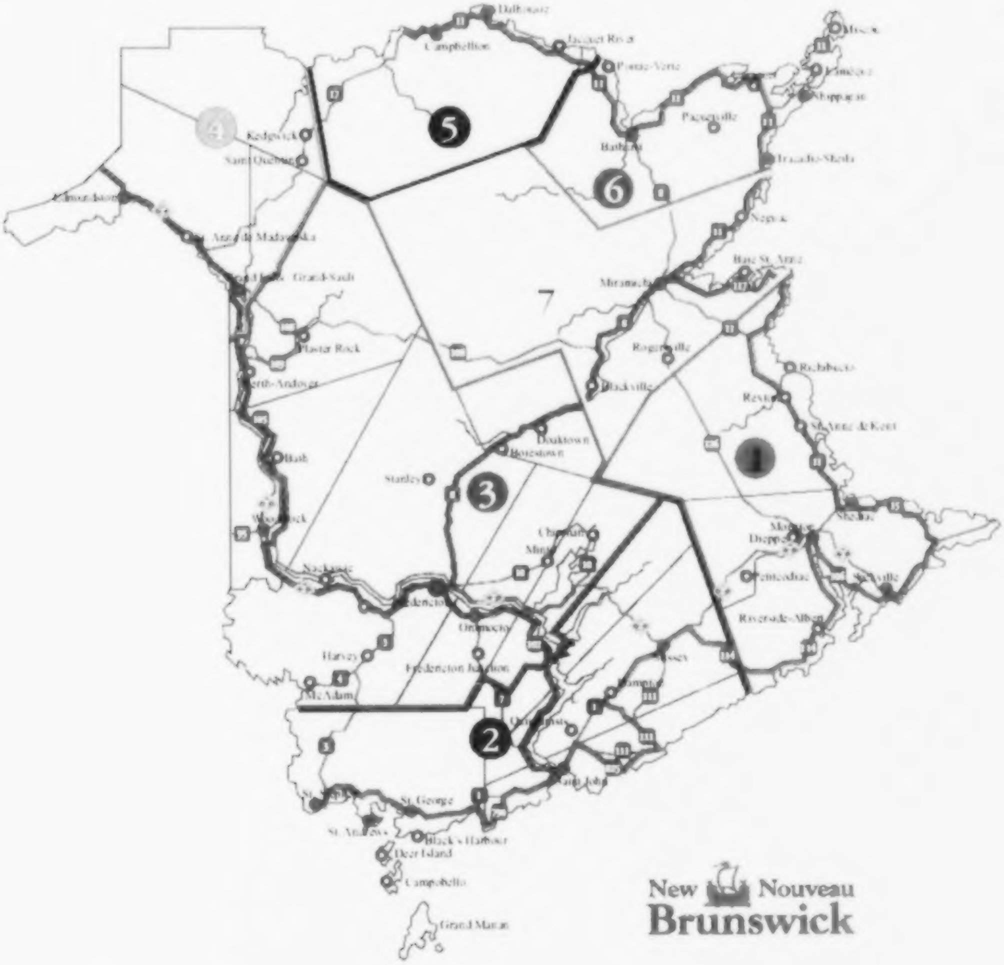


Figure 1.3: Map of New Brunswick Health Regions[1]


Dalhousie
Campbellton
Jacquet River
Pointe-Verte
Miscou
Lamèque
Shippagan
Paquetville
Bathurst
Tracadie-Sheila
Kedgwick
Saint-Quentin
Edmundston
Ste-Anne-de-Madawaska
Grand-Sault
Plaster Rock
Perth-Andover
Neguac
Baie St. Anne
Miramichi
Rogersville
Blackville
Richibucto
Rexton
St-Anne de Kent
Doaktown
Boiestown
Stanley
Bath
Woodstock
Nackawic
Chipman
Minto
Fredericton
Oromocto
Fredericton Junction
Harvey
McAdam
Shediac
Moncton
Dieppe
Petitcodiac
Sackville
Riverside-Albert
Sussex
Hampton
Quispamsis
Saint John
St. Stephen
St. George
St. Andrews
Black's Harbour
Deer Island
Campobello
Grand Manan
1
2
3
4
5
6
7
New Nouveau Brunswick

There were two sets of comparisons that were made with all identified health outcomes (see Figure 1.4). The first comparison was between the GBA and the rest of NB with Health Regions 5 and 6 removed. The second set of comparisons was between Health Regions 5 and 6 and the rest of NB. By setting up the comparisons in this manner, the study team were able to achieve two goals:

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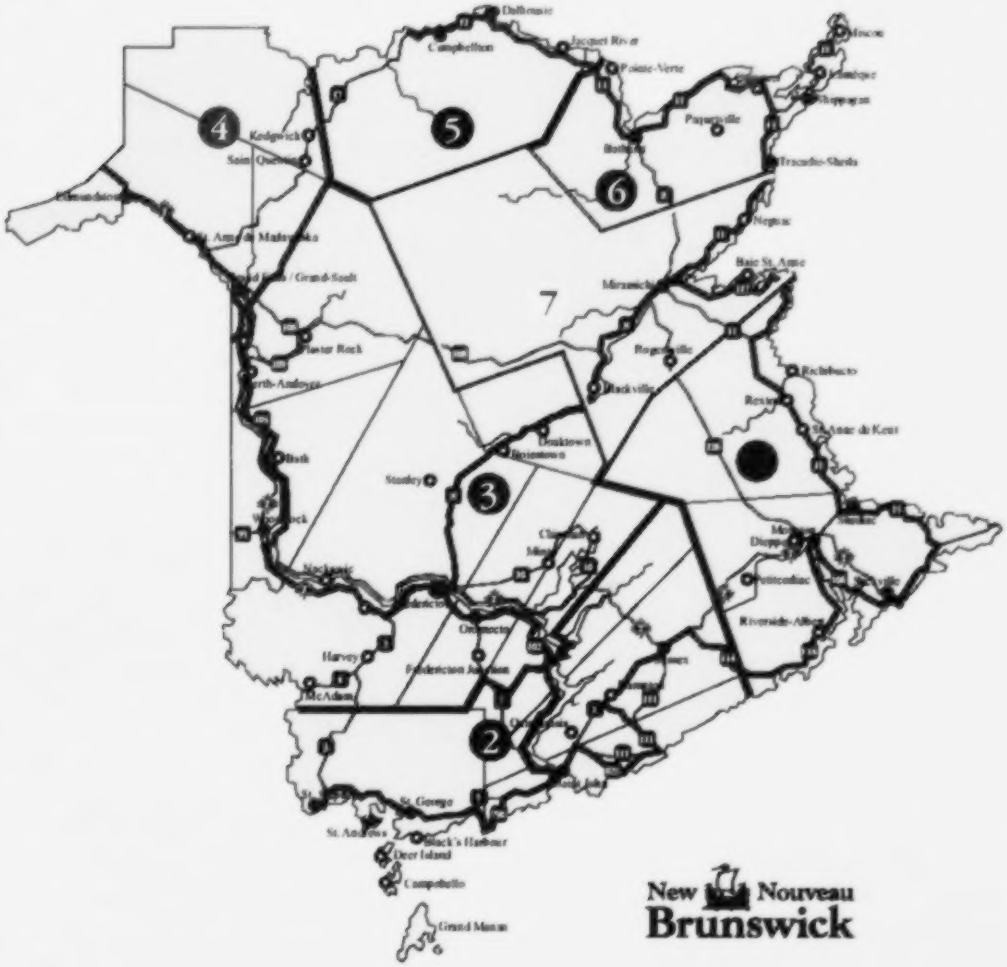
[1] New Brunswick Department of Health and Wellness website 2005. http://www.gnb.ca/0051/pdf/LatestRHAmap.pdf

Figure 1.3: Map of New Brunswick Health Regions[5]


Dalhousie
Campbellton
Jacquet River
Pointe-Verte
Miscou
Lamèque
Shippagan
Paquetville
Bathurst
Tracadie-Sheila
Kedgwick
Saint-Quentin
Edmundston
St. Anne de Madawaska
Grand Falls / Grand-Sault
Plaster Rock
Perth-Andover
Bath
Woodstock
Stanley
Boiestown
Doaktown
Blackville
Rogersville
Miramichi
Neguac
Baie St. Anne
Richibucto
Rexton
St. Anne de Kent
Chipman
Minto
Nackawic
Fredericton
Oromocto
Fredericton Junction
Harvey
McAdam
Petitcodiac
Riverside-Albert
Moncton
Dieppe
Sackville
Shediac
Sussex
Hampton
Saint John
St. Stephen
St. George
St. Andrews
Black's Harbour
Deer Island
Campobello
Grand Manan
2
3
4
5
6
7
New Nouveau Brunswick

There were two sets of comparisons that were made with all identified health outcomes (see Figure 1.4). The first comparison was between the GBA and the rest of NB with Health Regions 5 and 6 removed. The second set of comparisons was between Health Regions 5 and 6 and the rest of NB. By setting up the comparisons in this manner, the study team were able to achieve two goals:

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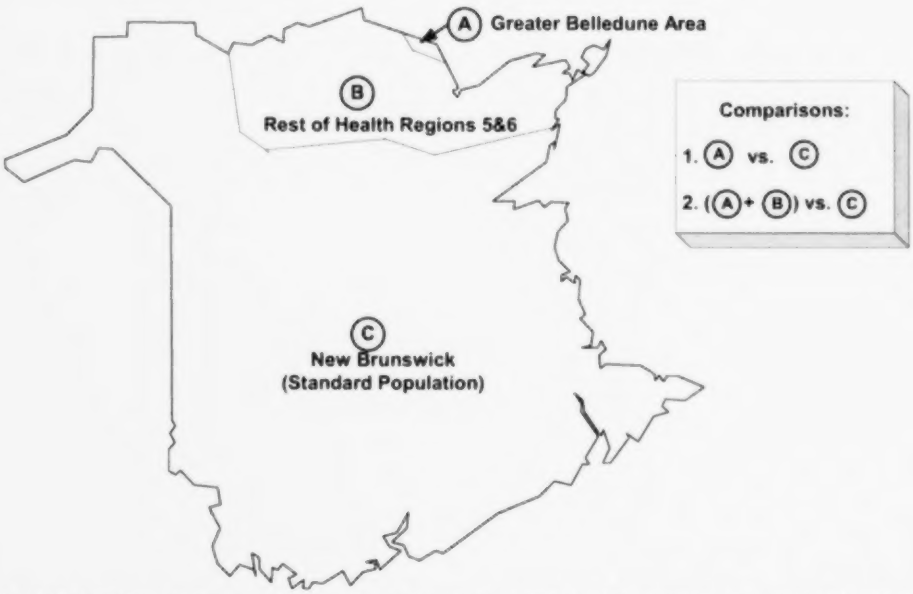
[5] New Brunswick Department of Health and Wellness website 2005, http://www.gnb.ca/0051/pdf/LatestRHAmap.pdf

- Determine which health problems were unique to the GBA and not consistent with the surrounding health regions; and,
- Have a sufficiently large reference population (NB less HR 5&6) to have stable rates to make statistical comparisons.

In Figure 1.4 below, Greater Belledune Area (designated as A) was compared to the referent population that is all of NB (excluding HR 5&6) designated by the letter C. For the second comparison, all of HR 5&6 (A+B) was compared to C (Standard Population).

Figure 1.4: Comparisons for CHSA



In defining the study population, it was important to take into account geographical boundaries as well as accessibility of readily available health data.

1.6.1 Geographical classification

The study team identified the GBA and HR 5&6 populations according to Statistics Canada's Standard Geographical Classification (SGC) system to map geographical areas within Canada. This classification is hierarchical in nature assigned in descending order going from the largest to the smallest geographical units. We defined the study populations based on the Census Subdivisions (CSDs) listed in Table 1.1 below.

Table 1.1 - Study populations and corresponding 2001 CSDs

Study Population	Census Subdivisions (SGC codes)	
Greater Belledune Area (GBA)	• Belledune (1314025)* • Pointe-Verte (1315013) • Petit-Rocher (1315014)	
Health Regions 5 and 6 (HR 5&6)	**Health Region 5** • Durham (1314001) • Colborne (1314003) • Charlo (1314004) • Balmoral Parish (1314005) • Balmoral Village (1314006) • Dalhousie (1314008) • Eel River 3 (1314010) • Eel River Crossing (1314011) • Addington (1314012) • Atholville (1314013) • Campbellton (1314014) • Tide Head (1314015) • Eldon (1314016) • Dalhousie (1314017) • Belledune (1314025)	**Health Region 6** • Saumarez (1315001) • Tracadie-Sheila (1315003) • Allardville (1315006) • Bathurst (1315008) • Pabineau 11 (1315010) • Bathurst (1315011) • Beresford Parish (1315012) • Pointe-Verte (1315013) • Petit Rocher (1315014) • Beresford Town (1315015) • New Bandon (1315016) • Saint-Léolin (1315017) • Paquetville Parish (1315019) • Paquetville Village (1315020) • Saint Isidore Parish (1315021) • Saint Isidore Village (1315022) • Inkerman (1315024) • Caraquet Parish (1315026) • Bas Caraquet (1315027) • Caraquet Town (1315028) • Shippagan Parish (1315029) • Le Goulet (1315030) • Shippagan Town (1315031) • Lamèque (1315032) • Sainte-Marie-Saint-Raphaël (1315033) • Bertrand (1315036) • Nigadoo (1315037) • Grande-Anse (1315038) • Maisonnette (1315040)

** Before 1995, Belledune was made up of Jacquet River (SGC- 14002) and Belledune (SGC- 15034).*

1.7 Data sources

The primary source for health data was the New Brunswick Department of Health and Wellness (DHW). Population data has been obtained from Statistics Canada for different census years: 1986, 1991, 1996, and 2001.

1.7.1 Vital Statistics Data

The Vital Statistics Branch within the New Brunswick Department of Health and Wellness is authorized to collect information of vital events for all permanent residents of New Brunswick under the Vital Statistics Act. These events include birth, death, and marriages.

1.7.2 Cancer Data

Information pertaining to cancer is routinely collected by cancer registries. In New Brunswick, the Provincial Cancer Registry operates under the auspices of the Provincial Epidemiology Service of the Department of Health and Wellness. The Registry is tasked with the responsibility of collecting, collating, and maintaining all malignancies that have occurred among residents of New Brunswick. To achieve this objective, the Registry employs a passive surveillance approach using secondary data from the Provincial Laboratories, Radiation Oncology Centres, and government agencies. Although there is no documentation regarding consistency in classification, completeness of registration, and validity of data recorded for the New Brunswick Cancer Registry, other cancer registries operated using similar passive approaches have demonstrated high level of completeness based on capture-recapture techniques[6].

1.7.3 Hospital Separation Data

Information regarding hospital admission and separation are routinely collected using standardized forms. At the end of each hospital stay, each patient is released from the hospital as a discharge, death, or transferred to another institution. Since one person could potentially be admitted and separated multiple times in a given year, hospital utilization is based on counts rather than individual patients.

1.8 Analyses

Prior to analyses, data quality was assessed by comparing frequencies of selected health outcome of interest (e.g., births, deaths, cancer incidence) from data provided by Department of Health and Wellness with external reports for consistency. External reports include those published by Statistics Canada (e.g. vital statistics), National Cancer Institute of Canada (e.g.,

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[6] Robles SC, Marrett LD, Clarke EA, Risch HA. An application of capture-recapture methods to the estimation of completeness of cancer registration. J Clin Epidemiol 1988;41:495-501.

Canadian Cancer Statistics), and Canadian Institute for Health Information (e.g., Hospital Separations). Small variations were expected. Most statistical analyses were conducted using SAS Version 9.1 for Windows, a statistical package developed by the SAS Institute Inc.

The analytical approach begins with basic descriptive statistics providing counts and percent distribution for selected health outcomes of interest (e.g., births, deaths, cancer etc). The purpose of this was to characterize the distribution of the event of interest by calendar year and gender when appropriate.

Crude rates were generated for selected measures of health status. To compare the incidence, morbidity, and mortality of two populations, a rate ratio was computed. In this study, this method was employed for the comparison of the rates for selected measures of health status of interest for study populations (Greater Belledune Area and Health Regions 5&6) to that of the New Brunswick standard population. A rate ratio in excess of 1.0 indicates that the study population has a higher rate than the standard population. To determine the precision of the rate ratios, 95% confidence interval (CI) and p-values were calculated.

In calculating rates for small areas, there are random variations likely due to small sample size resulting in inaccurate estimate of the true rate. In order to obtain a more stable estimate, years of observation (1989-2001) were combined and in some instances, similar health status indicators of interest were also collapsed (e.g., death due to neoplasm).

Equation 1.1 provides the equations used to calculate rate, rate ratio, and 95% CI for infant mortality rate, a common health status measure defined as the number of deaths among children under the age of 1 year divided by total number of live births in the same year. P-value was calculated via the Fleiss method.[7]

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[7] Fleiss JL, Statistical Methods for Rates and Proportions, Wiley and Sons, NY, 1973. p.14, Formula (2.1) and (2.2).

Equation 1.1 - Rate, rate ratio, and confidence intervals

$$\textbf{Infant Mortality Rate} = \frac{Death\,of\,Children < 1\,Year\,of\,\,age}{Total\,\,Live\,Births\,in\,Same\,Year} \times 1000$$

95% Confidence interval for rate:

Let: r = rate, n = denominator for the rate

Upper limit: $r + 1.96\sqrt{\frac{r}{n}}$ Lower limit: $r - 1.96\sqrt{\frac{r}{n}}$

95% Confidence interval for rate ratio:

Let: r_1 = rate for area 1, d_1 = number of death for area 1

r_2 = rate for area 2, d_2 = number of death for area 2

$$R = \frac{r_1}{r_2}$$

Upper limit: $R + 1.96R\sqrt{\frac{1}{d_1} + \frac{1}{d_2}}$ Lower limit: $R - 1.96R\sqrt{\frac{1}{d_1} + \frac{1}{d_2}}$

Source: Kleinman JC, Infant Mortality. Centers for Disease Control. National Center Health Statistics *Statistical Notes*, Winter 1991; 1(2): 1-11.

To compare relative health of populations, one must also take into account the number of events in the population at risk and the age structure of the population since most diseases generally increase with age. Younger population tends to have fewer deaths or disease events than a comparable sized older population. To effectively compare populations, standardization techniques must be used in order to make the comparison meaningful. Since the Belledune Area is a relatively small geographical area with small population, the most effective comparison can be achieved by using indirect standardization method where applicable. Standardized mortality/morbidity/incidence ratio (SMR/SIR) avoids the problem of imprecise estimate of stratum specific rates in the study population by taking more stable stratum-specific rates of a standard (reference) population. Strata specific weights of the standard population were applied to the corresponding age-strata of the study population to obtain the expected number of events. Equations used to calculate the standardized mortality ratio (SMR) and its confidence interval are shown in Equation 1.2. P-values were also calculated based on Kelsey.[x]

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[x] Kelsy JL, Whittemore AS, Evans AS, Thompson WD. Methods in Observational Epidemiology, 2nd Ed. Oxford University Press, Toronto, 1996

Equation 1.2 - Standardized Mortality Ratio and confidence intervals

Let:

d_i = Number of events in the i^{th} age group in the study population
n_i = Number of persons in the i^{th} age group for the study population
r_i = Age-specific event rate for the i^{th} age group among the study population
R_i = Age-specific event rate for the i^{th} age group among the standard population

$$SMR = \frac{Number\ of\ Observed\ Events}{Number\ of\ Expected\ Events} = \frac{\sum_i d_i}{\sum_i R_i * n_i}$$

$$95\%\ \mathrm{CI}_{(\mathrm{SMR})} = \mathrm{SMR} \pm 1.96\ \mathrm{SE}\ \text{where}\ \mathrm{SE} = (\textstyle\sum d_i)^{1/2} / \sum R_i n_i$$

2.0 Demographic profile

This section provides demographic and population profiles for the Greater Belledune Area in comparison with those of Health Regions 5&6 and the Province of New Brunswick.

2.1 Population

The Greater Belledune Area (GBA) and Health Regions 5&6 (HR 5&6) have demonstrated a decline in total population over the Census years 1991, 1996, and 2001 (Table 2.1). The province of NB showed an increase in total population between Census years 1991 and 1996, followed by a decline between 1996 and 2001. Overall the population of NB has declined from 1991 to present.

Table 2.1: Population by census years by geographical regions

Census Years	Greater Belledune Area N (% of NB)	Health Regions 5&6 N (% of NB)	New Brunswick N
1991	5,400 (0.72)	124,062 (16.64)	745,546
1996	5,338 (0.71)	122,218 (16.23)	752,995
2001	4,935 (0.68)	112,530 (15.47)	727,635

Source: Statistics Canada

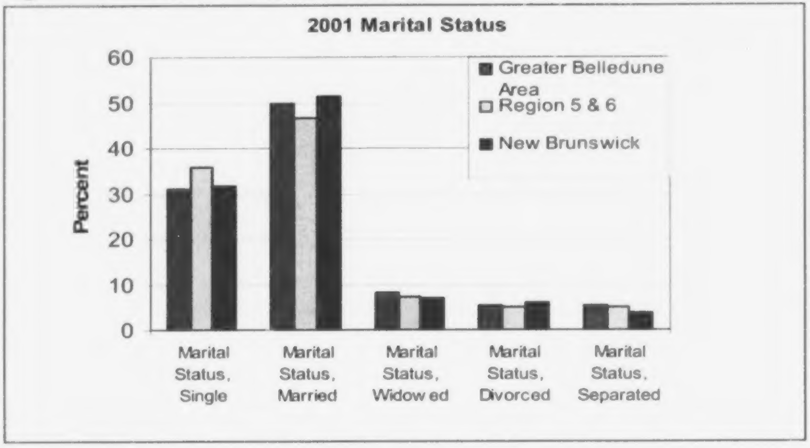
2.2 Age distribution

The population distribution of the GBA by age category is similar to that of HR 5&6 and the province of NB; however, some disparities exist. The most notable disparities exist in the age groups 20-29 and 50-59. The GBA has a lower proportion of people aged 20-29 when compared to Health Regions 5&6, and even lower when compared to NB overall. The GBA has a greater population of people aged 50-59 when compared to HR 5&6, and greater still when compared to NB.

2.3 Marital status

Recent census data demonstrates that the GBA has a similar composition of married couples, and widowed, separated or divorced individuals when compared to HR 5&6 and the province of NB (Figure 2.1).

Figure 2.1: Marital Status of Residents

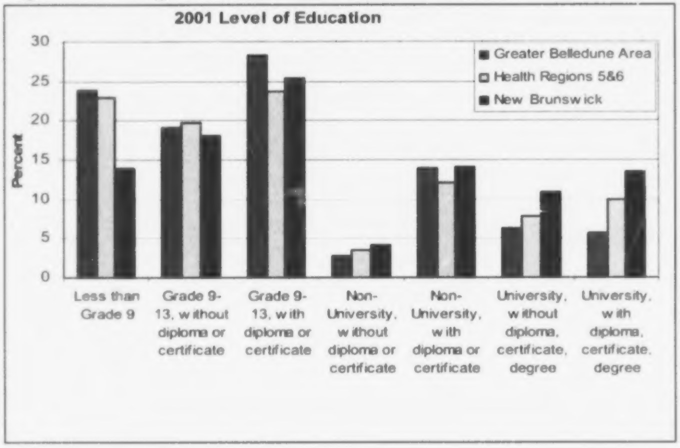


Source: Census 2001, Statistics Canada

2.4 Education

As illustrated in Figure 2.2, census data for people 20 years of age and older indicate that both the GBA and HR 5&6 have a higher proportion of people who have less than a high school diploma or certificate compared to NB figures. The GBA has a similar proportion of trade certificates and college diplomas (non-university, with diploma or certificate) when compared to Regions 5 & 6 and NB as a whole. With respect to university education, the GBA has the lowest percentage (5.6%) when compared to Regions 5 & 6 (10.0%) and NB (13.5%).

Figure 2.2: Highest level of education



Source: Census 2001, Statistics Canada

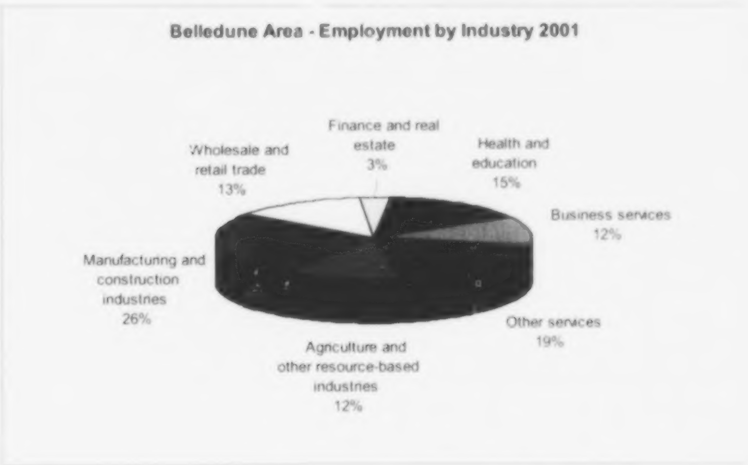
NOTE: It is noted that NB does not have Grade 13, however, the categories used in this graph are standard categories used by Statistics Canada. This ensures that NB residents who may have been educated elsewhere are included, and it allows for comparisons with Canada overall.

2.5 Employment and income

Data from the 2001 Census demonstrates that the Belledune Area offers a different composition of major types of employment from the NB provincial distribution (Figure 2.3). The greatest differences are seen in the Manufacturing and Construction industries and Agriculture and Other Resource-based industries. The Belledune Area is 7% above the NB average for Manufacturing and Construction and 4% above the provincial average for Agriculture and Other Resource-based industries. The Belledune Area is 4% below the provincial average for activity in the Business Services sector and 3% below average for activity in the Health and Education sector.

The largest single source of employment in the Belledune Area is the Noranda Smelter, employing over 650 individuals[9]. Other major employers in the area include the Port of Belledune, NB Power, Chaleur Sawmills and Canadian Gypsum.

Figure 2.3: Distribution of employment – GBA & NB



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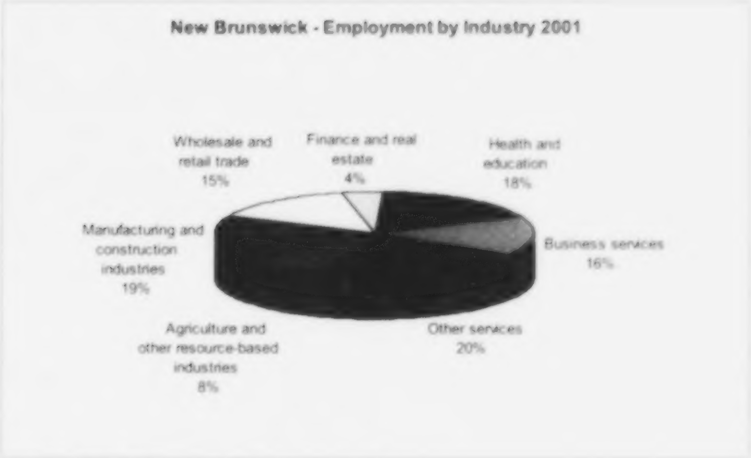
[9] Source: MITAC Member Site, 2003. http://www.mitac.ca/WebForms/about_mitac/membership_e.aspx



Source: 2001 Census, Statistics Canada

2001 Census data show that the employment rate in the GBA (83.4%) is similar to that of Regions 5 & 6 (82.9%), and slightly lower than NB overall (87.5%). Census data from 2001 also demonstrated that average household income for GBA ($42,821) was very similar to that of HR 5&6 ($42,378). Average household income was approximately $5,000 lower than that for NB overall ($47,587)

1.3.6 Language

According to the 2001 Census, the GBA varies from the NB linguistic distribution with 60% of the area's population reporting that their first language is French, and 39%, English. This compares with the distribution of 33% French and 65% English for NB overall. Within the GBA there are variations, with many in the Belledune community with English as a first language, while many residents in Pointe-Verte and Petit-Rocher have French as their first language.

3.0 Reproductive outcomes and mortality

In the section, the study team describes the findings obtained with respect to the analyses conducted using the vital statistics data for births, deaths, stillbirths, and congenital anomalies identified at birth.

The data quality checks demonstrated that the analysis of the data files obtained from the DHW matched closely the published reports. There were only a very few exceptions (<1% of total cases) that required the study team to make judgment calls to remove these specific data from the analyses. These included:

- 40 people with unknown age; and,
- 2 people with age coded as 132 years.

3.1 Approach for reproductive outcomes

Reproductive outcomes are an extremely useful measure of the health status of a community. They synthesize many measures of pre-pregnancy health status (nutrition and chronic disease), pregnancy care, work status of the mother, access to health care, socioeconomic status, social support and environmental exposures.

The factors that contribute to low birth weight are complex. Adverse reproductive outcomes such as low birth weight (weight less than 2500 grams) reflect nutritional and smoking status of the mother, and they prognosticate developmental behavior of the child, including survival in the first year of life.[10] Most recently they also reflect multiple birth frequency, as this is associated with lower birth weight. Most importantly, they also present an outcome which makes sense to study recent exposures of the fetus derived from maternal exposures over a precise period of time, nine months, and from recent environmental exposures just prior to pregnancy. Pregnancy offers a short observation period in comparison to the long period required after exposure to observe the occurrence of cancer.

Characteristics of a birth are gathered systematically for the population in the vital statistics database. Among these are age of mother, vital status (live or stillbirth), birth weight, gestational age, and presence of a birth defect. Because of the high quality of the birth data, the short period of potential environmental influences on the fetus, reproductive outcomes may be used as a mirror of environmental, social and health care influences. In short, they are a good measure of population health status overall.

Smoking is one of the most pervasive toxicants in pregnancy. The effects of smoking are reflected in slowed fetal intrauterine growth and in prematurity.[11]

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[10] Ananth CV, Platt RW. Reexamining the effects of gestational age, fetal growth, and maternal smoking on neonatal mortality. BMC Pregnancy and Childbirth 2004, 4:22 doi:10.1186/1471-2393-4-22

[11] [11] Statistics Canada (1999) and Federal Provincial Committee on Population Health.

Birth defects may be associated with nutritional deficiencies (folic acid and spinal cord defects), drugs (vitamin A congeners and ear defects), alcohol (fetal alcohol syndrome) and potentially low-level environmental toxicant effects.[12]

For the purposes of the present study, the team studied rate ratios for:
- live births;
- low birth weights (less than 2500g);
- stillbirths; and,
- birth anomalies (birth defects namely ICD-9: 740-759).

These analyses focused on the time period of 1989-2001.

3.2 Approach for measuring mortality

The mortality rates and causes for GBA and HR 5&6 were studied using the vital statistics data. The cause of death was according to the following ICD-9 codes and covered the period 1989-2001:

- All causes of death
- Neoplasms (ICD-9: 140-208)
- Endocrine & metabolic disease (ICD-9: 240-279)
- Nervous system and sense organs diseases (ICD-9: 320-349)
- Circulatory system disease (ICD-9: 390-459)
- Respiratory system disease (ICD-9: 460-519)
- Digestive system disease (ICD-9: 520-579)
- Genitourinary system disease (ICD-9: 580-629)
- Skin & subcutaneous tissue disease (ICD-9: 680-709)
- Musculoskeletal and connective tissue disease (ICD-9: 710-739)
- Congenital anomalies (ICD-9: 740-759)
- Conditions originating from the perinatal period (ICD-9: 760-779)
- Other causes (e.g., accidents, suicide)

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[12] The Motherisk Program. The Hospital for Sick Children, Toronto, Ontario

3.3 Findings

3.3.1 General descriptives

Live births

As illustrated in Tables 3.1 and 3.2, the population of NB is declining, along with live births and associated birth disorders. The number of live births over the period studied has decreased approximately 25% for NB between 1989 and 2001. Over the same period, the number of births decreased by approximately 40% in HR 5&6, and approximately 60% in the GBA. Table 3.2 shows that the total number of live births recorded in the GBA during this period was 897.

Deaths

Table 3.3 contains the counts for deaths according to various causes. During 1989-2001, there were a recorded 632 deaths in the GBA with leading causes of death being circulatory system disease (N=226), cancer (N=217), "other causes" such as accidents and suicide (N=70), and respiratory system disease (N=44)

Table 3.1: Summary vital statistics, New Brunswick 1989-2001

Year	Vital Statistics						
	Population*	Live Births	Deaths	Infant Deaths[1]	Neonatal Deaths[2]	Stillborn	Congenital Anomalies[3]
1989	737,994	9,651	5,553	69	49	57	51
1990	742,955	9,818	5,513	73	53	66	28
1991	745,546	9,493	5,593	63	38	57	41
1992	748,463	9,385	5,699	61	46	53	48
1993	749,530	9,041	5,819	64	44	49	60
1994	750,942	8,965	5,925	49	34	59	42
1995	751,782	8,556	5,941	41	21	32	41
1996	752,995	8,172	5,902	40	24	42	40
1997	754,237	7,907	5,950	45	30	47	29
1998	753,421	7,868	6,310	51	36	39	19
1999	754,348	7,605	6,080	38	23	52	18
2000	756,598	7,340	6,094	26	22	38	19
2001	727,635	7,141	5,990	26	14	41	14
Total	9,726,446	110,942	76,369	646	434	632	450

** Census years: 1991, 1996, 2001, others are inter/post-censal years estimated populations.*

[1] Infant (under 1 year of age), [2] Neonatal (under 28 days), and [3]Congenital anomalies are based on ICD-9: 740-759.

Table 3.2: Number of live births by year and geographic area, 1989-2001

Years	Greater Belledune Area	Health Regions 5 & 6	New Brunswick
1989	84	1,485	9,651
1990	99	1,524	9,818
1991	85	1,451	9,493
1992	88	1,400	9,385
1993	82	1,293	9,041
1994	78	1,297	8,965
1995	75	1,203	8,556
1996	52	1,044	8,172
1997	64	1,162	7,907
1998	53	1,054	7,868
1999	48	979	7,605
2000	49	982	7,340
2001	40	905	7,141
Total	897	15,779	110,942

Source: New Brunswick Department of Health and Wellness, Vital Statistics

Table 3.3: Deaths from selected disease classification (ICD-9 codes) in Greater Belledune Area, Health Regions 5& 6, and all of New Brunswick by year, 1989-2001

Year	Neoplasm (140-208)			Endocrine & metabolic (240-279)			Nervous system and sense organs (320-389)			Circulatory system (390-459)			Respiratory system (460-519)			Digestive system (520-579)		
	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB
1989	15	213	1,370	**	21	174	**	19	172	11	305	2,397	**	62	460	**	35	184
1990	17	244	1,490	**	24	166	**	19	151	23	315	2,215	**	59	419	**	31	182
1991	15	247	1,513	**	22	155	**	22	161	21	323	2,312	**	65	447	**	27	205
1992	24	233	1,550	**	20	174	**	31	174	15	298	2,274	**	79	445	**	28	205
1993	21	240	1,578	**	33	191	**	20	160	17	338	2,308	**	71	482	**	12	160
1994	10	235	1,577	**	22	180	**	27	165	29	332	2,371	6	107	546	**	30	208
1995	11	237	1,648	**	25	195	**	20	200	13	310	2,302	**	59	486	**	31	193
1996	27	272	1,617	**	53	231	**	22	179	11	302	2,238	**	78	533	**	30	179
1997	15	251	1,631	**	51	251	**	29	186	17	290	2,279	**	78	515	**	28	208
1998	24	292	1,738	**	34	243	**	31	207	19	296	2,334	**	83	589	**	42	235
1999	14	273	1,612	**	56	248	**	21	198	17	333	2,268	**	82	588	**	30	206
2000	7	257	1,664	**	56	259	**	39	284	18	301	2,153	**	70	543	**	25	223
2001	17	280	1,675	**	38	253	**	42	289	15	298	2,100	**	67	492	**	39	223
Total	217	3,274	20,663	21	455	2,720	16	342	2,526	226	4,041	29,551	44	960	6,545	22	388	2,611

*Source: New Brunswick Department of Health and Wellness, Vital Statistics ** suppression of data due to small numbers*

Table 3.3 (Cont.): Deaths from selected disease classification (ICD-9 codes) in Greater Belledune Area, Health Regions 5& 6, and all of New Brunswick by year, 1989-2001

	Genitourinary System (580-629)			Skin & Subcutaneous tissue (680-709)			Musculoskeletal and connective tissue (710-739)			Congenital anomalies (740-759)			Conditions originated from the perinatal period (760-779)			Other causes			All Causes		
Year	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB	GBA	HR 5&6	NB
1989	**	10	76	0	**	**	**	**	18	**	6	46	0	**	27	8	123	627	42	796	5,553
1990	**	19	102	0	**	**	**	**	24	**	9	43	0	**	30	**	121	686	53	847	5,513
1991	**	11	91	0	**	**	**	**	27	**	9	38	0	**	19	6	109	622	49	841	5,593
1992	**	17	99	0	**	**	**	**	25	**	7	37	0	**	22	8	120	692	54	841	5,699
1993	**	15	95	0	**	**	**	9	33	**	6	39	0	**	29	6	110	742	50	854	5,819
1994	**	16	110	0	**	**	**	**	28	**	**	24	0	**	22	7	121	692	56	901	5,925
1995	**	19	87	0	**	6	**	10	32	**	**	23	0	**	13	6	123	756	39	836	5,941
1996	**	14	114	0	**	12	**	**	26	**	**	27	0	**	11	7	123	735	61	902	5,902
1997	**	18	101	0	**	5	**	**	25	**	**	25	0	**	19	**	107	705	48	862	5,950
1998	**	29	123	0	**	7	**	7	24	**	**	20	0	**	26	**	121	764	54	945	6,310
1999	**	17	128	0	**	**	**	6	34	**	**	27	0	**	15	**	133	752	46	957	6,080
2000	**	17	129	0	**	7	**	**	38	**	**	19	0	**	15	**	138	760	33	912	6,094
2001	**	28	131	0	**	8	**	8	61	**	**	16	0	**	15	**	147	727	47	951	5,990
Total	9	230	1,386	0	6	65	**	64	395	**	60	384	0	29	263	70	1,596	9,260	632	11,445	76,369

*Source: New Brunswick Department of Health and Wellness, Vital Statistics ** suppression of data due to small numbers*

3.3.2 Comparisons between GBA and the NB Standard

Rate ratios by year for live births
As illustrated in Figure 3.1 below, the rate ratio for live births in the GBA was statistically significantly higher overall with elevations occurring earlier in the time period (1989 and 1990).

Rate ratios by year for deaths
Figure 3.2 contains the rate ratios for deaths in the GBA. The rate ratio for deaths was statistically significantly elevated overall for the time period. Statistically significant elevations occurred in both 1990 and 1996.

Rate ratios by year for low birth weight
As illustrated in Table 3.4, there were 45 out of 897 babies born who weighed less than 2500g in the GBA during the time period (1989-2001). This produced a crude rate of 50.17 low birth weight babies for every 1,000 births. When compared with the NB standard, there was no statistically significant elevation.

Rate ratios by year for congenital anomalies
Table 3.5 contains the data for congenital anomalies for the GBA and NB standard. During this period there were less than five babies born with a birth defect. The rate ratio was not statistically significant.

SMR for overall, males and females
Figures[13] 3.3, 3.4, and 3.5 contain the SMRs for the GBA. During the period 1989-2001, overall mortality in the GBA population from *all causes of death* was elevated when compared with what one would expect. As illustrated in Figure 3.3 below, when the study team examined specific causes of death, it found more deaths in the GBA were due to *circulatory diseases* and *cancer* than what was expected.

As illustrated in Figure 3.4, when the study looked at deaths according to sex, the same pattern as described above emerged for male deaths. One additional cause of death that was elevated for males was "other causes" which include causes such as deaths due to accidents or suicide.

As illustrated in Figure 3.5 below, when the study team examined the number of female deaths in the GBA, it was noted that the GBA male-female mortality pattern differs. Only one category for female residents of GBA, deaths due to cancer, showed results elevated over what would be expected when compared to rates of death in NB.

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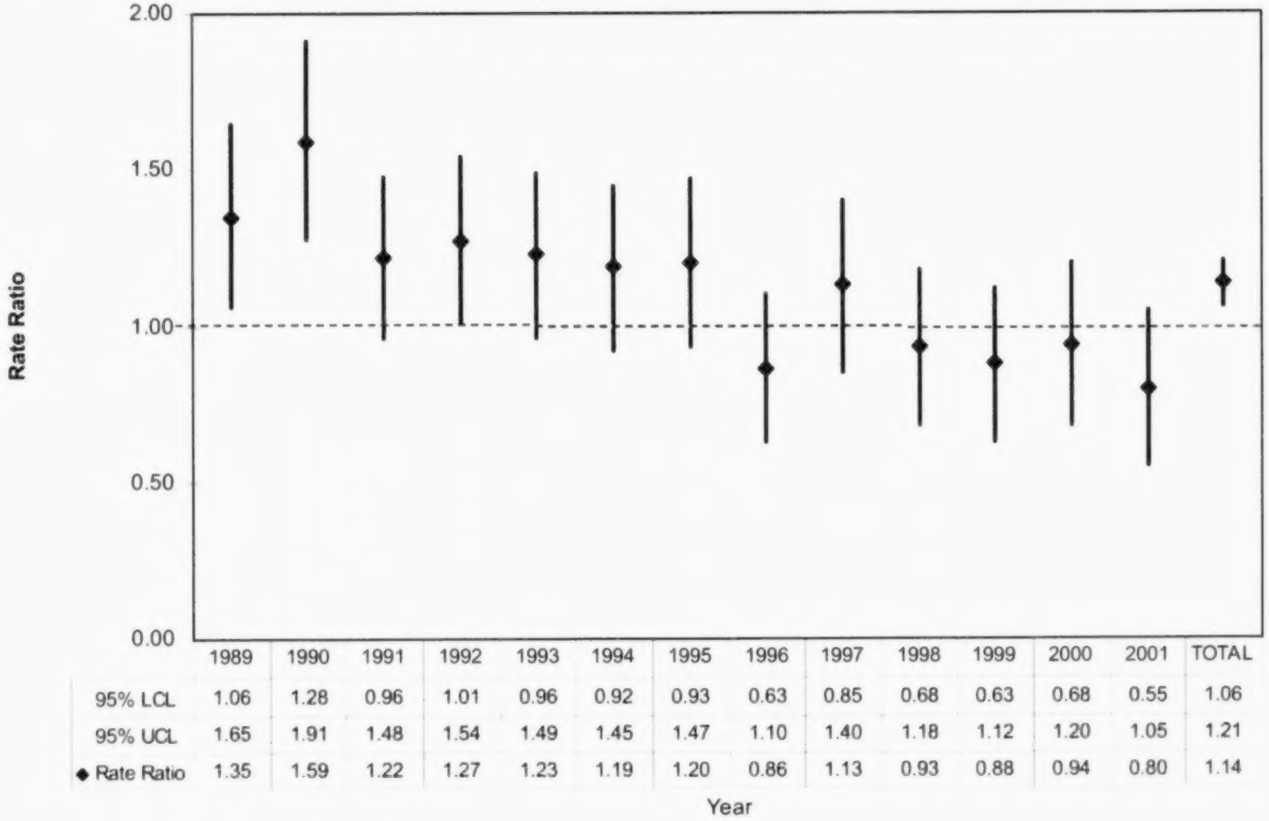
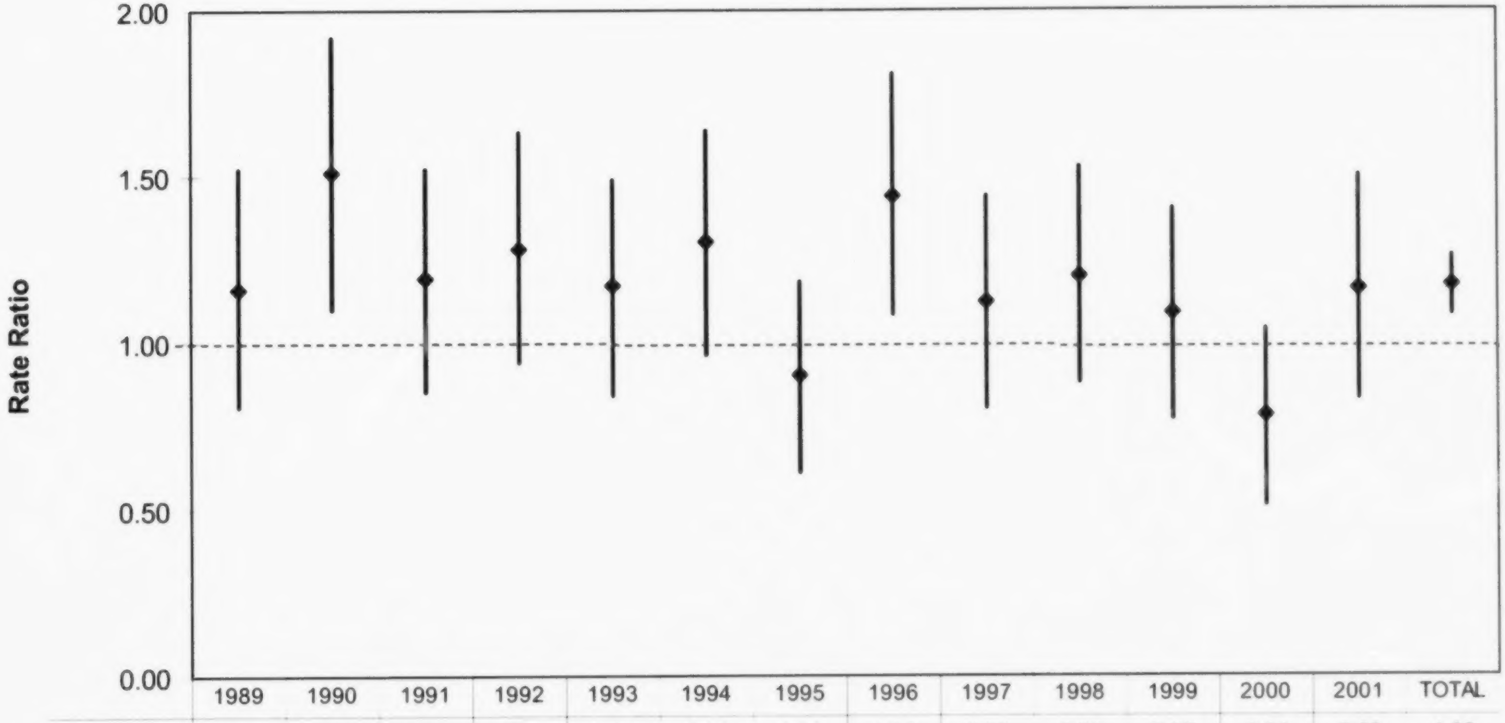
[13] The figures used throughout this section contain a graphical depiction of Standardized Mortality Ratios, and/or Standardized Incidence Ratios. Each vertical line on the graph represents one ratio. The diamond symbol represents the exact ratio, while the vertical line on either side of the diamond represents the 95% upper/lower confidence interval for the ratio. The ratio is considered to be statistically significant if neither of the vertical lines touch the horizontal line (ratio =1.00). Actual p-values are provided in Appendix DA.

Figure 3.1: Rate ratios of births for Greater Belledune Area compared to New Brunswick Standard Population, 1989 -2001.



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
95% LCL	1.06	1.28	0.96	1.01	0.96	0.92	0.93	0.63	0.85	0.68	0.63	0.68	0.55	1.06
95% UCL	1.65	1.91	1.48	1.54	1.49	1.45	1.47	1.10	1.40	1.18	1.12	1.20	1.05	1.21
◆ Rate Ratio	1.35	1.59	1.22	1.27	1.23	1.19	1.20	0.86	1.13	0.93	0.88	0.94	0.80	1.14

Figure 3.2: Rate ratios of deaths for Greater Belledune Area compared to New Brunswick Standard Population, 1989-2001.



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
95% LCL	0.81	1.10	0.85	0.94	0.84	0.96	0.61	1.08	0.80	0.88	0.77	0.51	0.83	1.08
95% UCL	1.52	1.92	1.52	1.63	1.49	1.64	1.18	1.81	1.44	1.53	1.40	1.04	1.50	1.26
◆ Rate Ratio	1.16	1.51	1.19	1.28	1.17	1.30	0.90	1.44	1.12	1.20	1.09	0.78	1.16	1.17

Year

Table 3.4: Low birth weight by year for Greater Belledune Area (GBA) and New Brunswick Standard Population, 1989-2001

Year	Greater Belledune Area				New Brunswick Standard Population				Rate Ratio	95% LCL	95% UCL	P value
	Birth Weight			Rate*	Birth Weight			Rate*				
	Total births (%)	< 2,500 g (%)	≥ 2,500 g (%)		Total births (%)	< 2,500 g (%)	≥ 2,500 g (%)					
1989	84 (9.36)	**	**	**	8,166 (8.58)	472 (9.32)	7,694 (8.54)	57.80	1.24	0.24	2.23	**
1990	99 (11.04)	**	**	**	8,294 (8.72)	410 (8.09)	7,884 (8.75)	49.43	0.41	0.00	0.98	**
1991	85 (9.48)	**	**	**	8,042 (8.45)	447 (8.83)	7,595 (8.43)	55.58	0.63	0.00	1.36	**
1992	88 (9.81)	**	**	**	7,985 (8.39)	435 (8.59)	7,550 (8.38)	54.48	0.63	0.00	1.34	**
1993	82 (9.14)	**	**	**	7,748 (8.14)	433 (8.55)	7,315 (8.12)	55.89	1.09	0.13	2.05	**
1994	78 (8.70)	**	**	**	7,668 (8.06)	456 (9.00)	7,212 (8.00)	59.47	0.43	0.00	1.03	**
1995	75 (8.36)	7 (15.56)	68 (7.98)	93.33	7,353 (7.73)	344 (6.79)	7,009 (7.78)	46.78	2.00	0.50	3.49	0.11
1996	52 (5.80)	**	**	**	7,128 (7.49)	370 (7.31)	6,758 (7.50)	51.91	0.74	0.00	1.77	**
1997	64 (7.13)	**	**	**	6,745 (7.09)	353 (6.97)	6,392 (7.09)	52.34	1.49	0.18	2.81	**
1998	53 (5.91)	**	**	**	6,814 (7.16)	371 (7.32)	6,443 (7.15)	54.45	1.04	0.00	2.22	**
1999	48 (5.35)	**	**	**	6,626 (6.96)	364 (7.19)	6,262 (6.95)	54.94	0.38	0.00	1.12	**
2000	49 (5.46)	**	**	**	6,358 (6.68)	295 (5.82)	6,063 (6.73)	46.40	0.88	0.00	2.10	**
2001	40 (4.46)	**	**	**	6,236 (6.55)	315 (6.22)	5,921 (6.57)	50.51	1.98	0.03	3.93	**
TOTAL	897 (100.00)	45 (100.00)	852 (100.00)	50.17	95,163 (100.00)	5,065 (100.00)	90,098 (100.00)	53.22	0.94	0.67	1.22	0.69

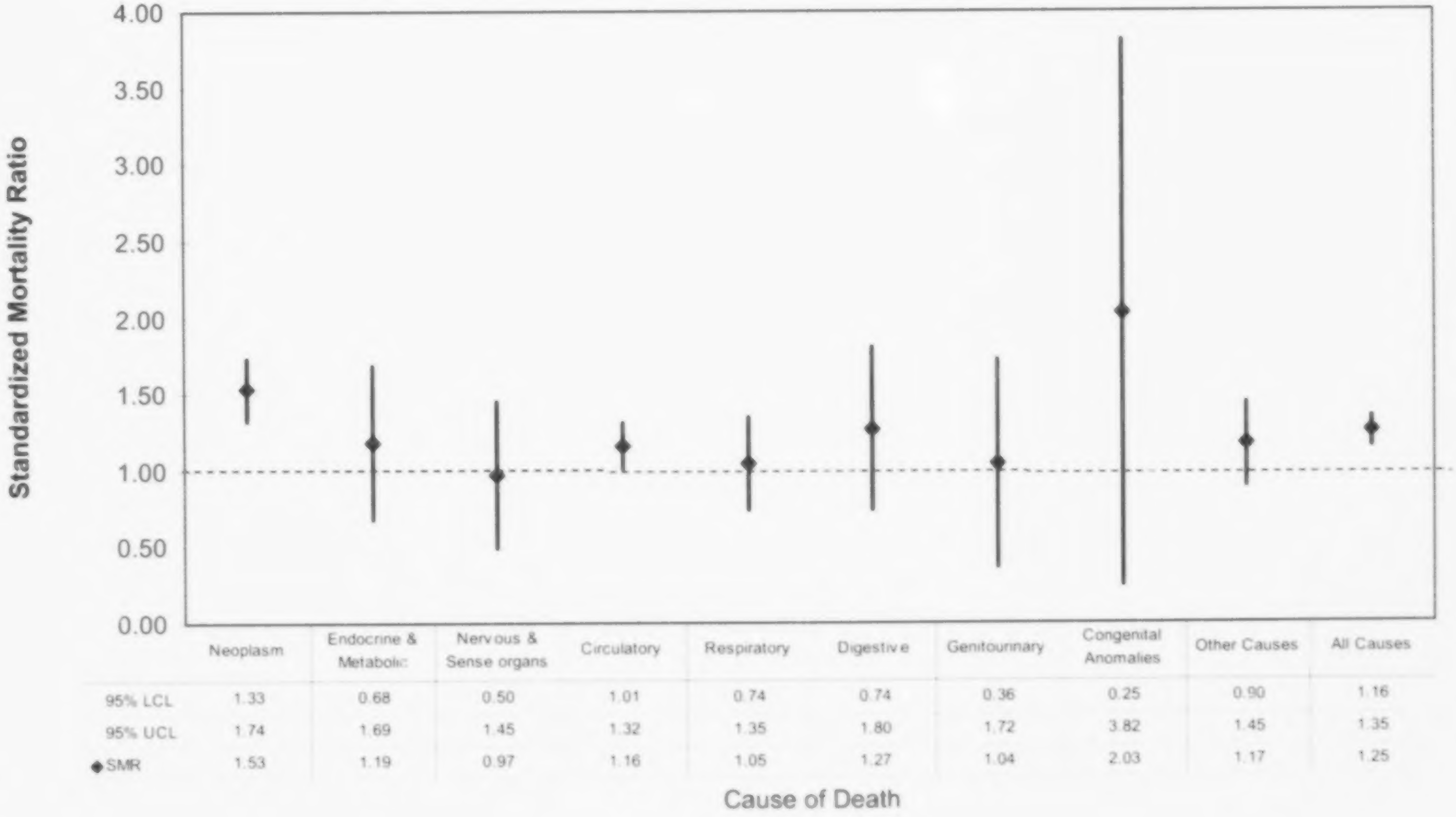
*Note: *Rates shown for low births weights are crude rates per 1,000 births. Populations from census years (1991, 1996, 2001) otherwise they are inter-censal estimates obtained from New Brunswick Health and Wellness. ** suppression of data due to small numbers*

Table 3.5: Congenital anomalies (ICD-9:740-759) by year for Greater Belledune Area (GBA) and New Brunswick Standard Population, 1989-2001

Year	Greater Belledune Area			New Brunswick Standard Population			Rate Ratio	95% LCL	95% UCL	P value
	Total births (%)	Congenital Anomalies	Rate*	Total births (%)	Congenital Anomalies	Rate*				
1989	84 (9.36)	0 (0.00)	0.00	8,166 (8.58)	43 (11.08)	5.27	-	-	-	
1990	99 (11.04)	0 (0.00)	0.00	8,294 (8.72)	24 (6.19)	2.89	-	-	-	
1991	85 (9.48)	0 (0.00)	0.00	8,042 (8.45)	34 (8.76)	4.23	-	-	-	
1992	88 (9.81)	0 (0.00)	0.00	7,985 (8.39)	41 (10.57)	5.13	-	-	-	
1993	82 (9.14)	**	**	7,748 (8.14)	56 (14.43)	7.23	**	**	**	**
1994	78 (8.70)	**	**	7,668 (8.06)	30 (7.73)	3.91	**	**	**	**
1995	75 (8.36)	0 (0.00)	0.00	7,353 (7.73)	37 (9.54)	5.03	-	-	-	
1996	52 (5.80)	0 (0.00)	0.00	7,128 (7.49)	34 (8.76)	4.77	-	-	-	
1997	64 (7.13)	0 (0.00)	0.00	6,745 (7.09)	24 (6.19)	3.56	-	-	-	
1998	53 (5.91)	0 (0.00)	0.00	6,814 (7.16)	18 (4.64)	2.64	-	-	-	
1999	48 (5.35)	**	**	6,626 (6.96)	15 (3.87)	2.26	**	**	**	**
2000	49 (5.46)	0 (0.00)	0.00	6,358 (6.68)	18 (4.64)	2.83	-	-	-	
2001	40 (4.46)	0 (0.00)	0.00	6,236 (6.55)	14 (3.61)	2.25	-	-	-	
TOTAL	897 (100.00)	**	**	95,163 (100.00)	388 (100.00)	4.08	**	**	**	**

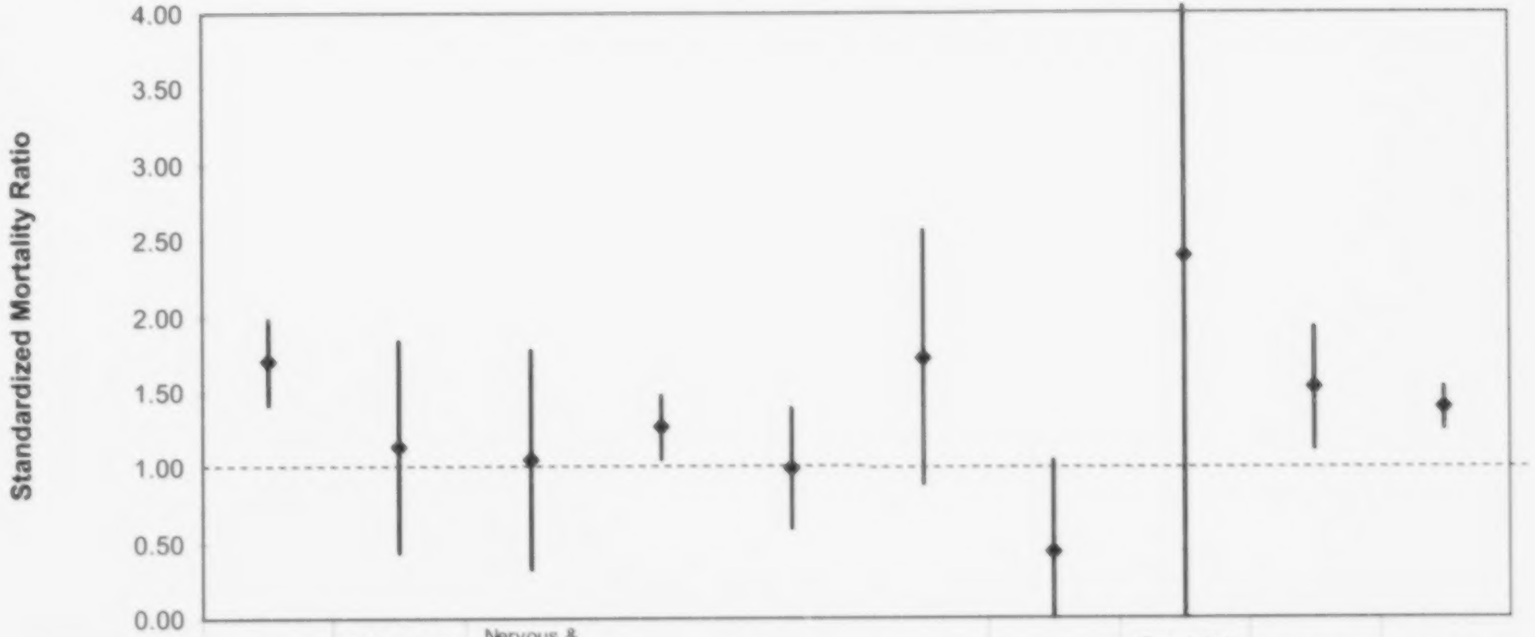
*Note: *Rates shown for congenital anomalies are crude rates per 1,000 births. Populations from census years (1991, 1996, 2001) otherwise they are inter-censal estimates obtained from New Brunswick Health and Wellness. ** Data suppressed due to small number of observed events.*

Figure 3.3: Standardised mortality ratio for selected causes of death for Greater Belledune Area, males and females combined, 1989-2001.



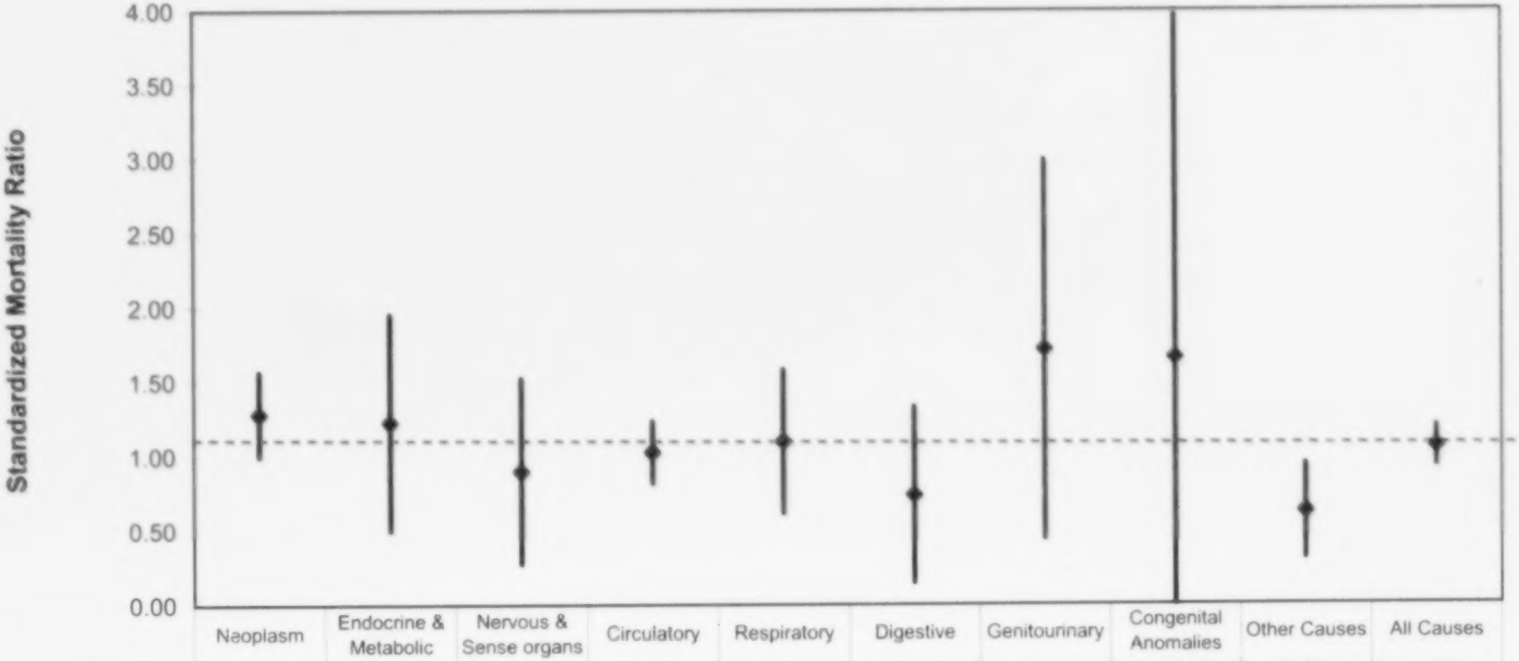
	Neoplasm	Endocrine & Metabolic	Nervous & Sense organs	Circulatory	Respiratory	Digestive	Genitourinary	Congenital Anomalies	Other Causes	All Causes
95% LCL	1.33	0.68	0.50	1.01	0.74	0.74	0.36	0.25	0.90	1.16
95% UCL	1.74	1.69	1.45	1.32	1.35	1.80	1.72	3.82	1.45	1.35
◆SMR	1.53	1.19	0.97	1.16	1.05	1.27	1.04	2.03	1.17	1.25

Figure 3.4: Standardised mortality ratio for selected causes of death for Greater Belledune Area, males only, 1989-2001.



	Neoplasm	Endocrine & Metabolic	Nervous & Sense organs	Circulatory	Respiratory	Digestive	Genitourinary	Congenital Anomalies	Other Causes	All Causes
95% LCL	1.42	0.43	0.32	1.05	0.59	0.88	0.00	0.00	1.12	1.25
95% UCL	1.99	1.84	1.78	1.48	1.38	2.56	1.03	5.11	1.92	1.53
◆ SMR	1.70	1.14	1.05	1.26	0.99	1.72	0.43	2.40	1.52	1.39

Figure 3.5: Standardised mortality ratio for selected causes of death for Greater Belledune Area, females only, 1989-2001.



	Neoplasm	Endocrine & Metabolic	Nervous & Sense organs	Circulatory	Respiratory	Digestive	Genitourinary	Congenital Anomalies	Other Causes	All Causes
95% LCL	1.00	0.50	0.28	0.82	0.62	0.15	0.45	0.00	0.31	0.93
95% UCL	1.57	1.96	1.52	1.24	1.58	1.33	2.99	3.97	0.95	1.20
◆ SMR	1.28	1.23	0.90	1.03	1.10	0.74	1.72	1.66	0.63	1.07

Cause of Death

3.3.2 Comparisons between HR 5&6 and the NB Standard

Rate ratios by year for live births
As illustrated in Figure 3.6 below, the rate ratio for live births in the HR 5&6 was statistically significantly lower overall and for each year within the time period.

Rate ratios by year for deaths
Figure 3.7 contains the rate ratios for deaths in the HR 5&6. The rate ratio for deaths was statistically significantly lower overall for the time period.

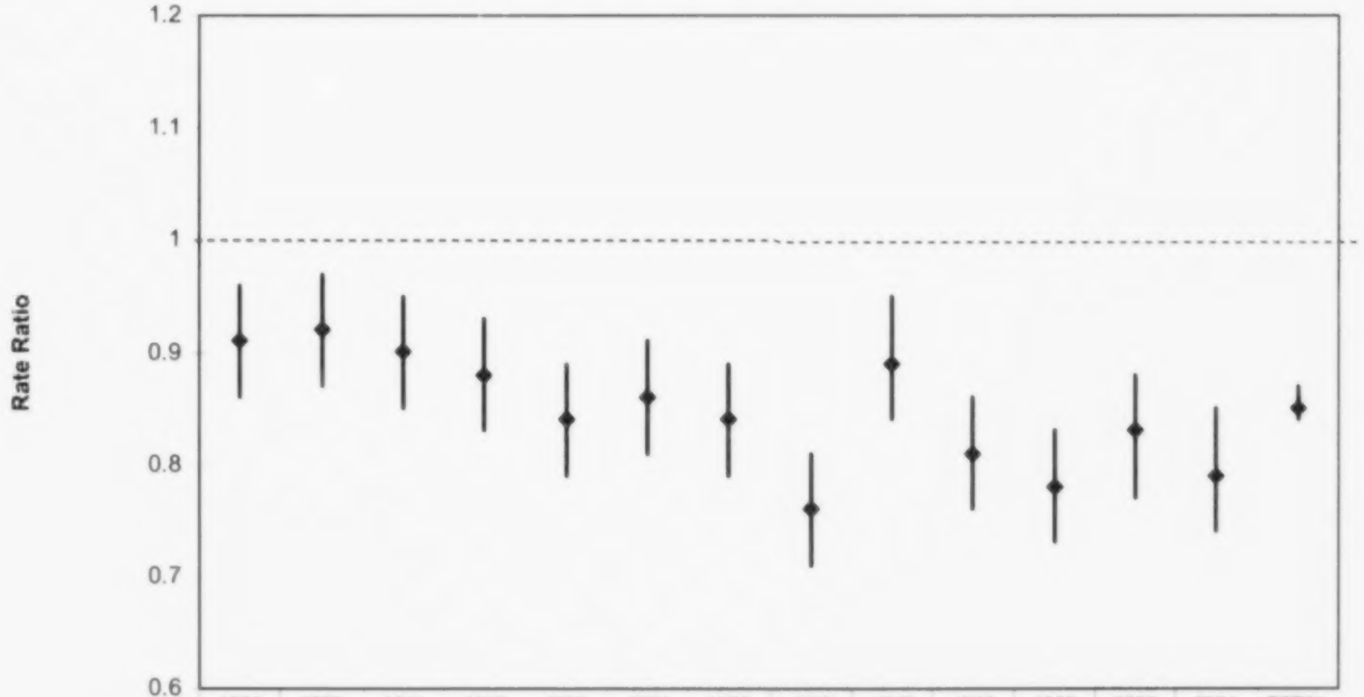
Rate ratios by year for low birth weight
As illustrated in Table 3.6, there were 859 (out of 15,779 babies born) who weighed less than 2500g in the HR 5&6 during the time period (1989-2001). This produced a crude rate of 54.44 low birth weight babies for every 1,000 births. When compared with the NB standard, there was no statistically significant elevation.

Rate ratios by year for congenital anomalies
Table 3.7 contains the data for congenital anomalies for the HR 5&6 and NB standard. During this period there were 62 (out of 15,779 babies born) who had a birth defect. The rate ratio was not statistically significant when compared with the NB standard.

SMR for overall, males and females
Figures 3.8, 3.9, and 3.10 contain the SMRs for the HR 5&6. During the period 1989-2001, when compared with the rest of NB, the residents of HR 5&6 (which includes GBA) have elevated numbers of deaths due to *endocrine and metabolic diseases*, and "*other causes*".

As illustrated in Figure 3.9, when male residents of HR5&6 were compared with the rest of NB males, they had an elevated number of deaths due to "*other causes*"
As illustrated in Figure 3.10, overall, female residents in HR 5&6 had *fewer deaths* than expected when compared with NB. With respect to specific causes of death, female residents of HR 5&6, compared with the rest of NB females, have an elevated number of deaths due to *endocrine and metabolic diseases* and fewer deaths than expected due to *circulatory* and *respiratory disease*.

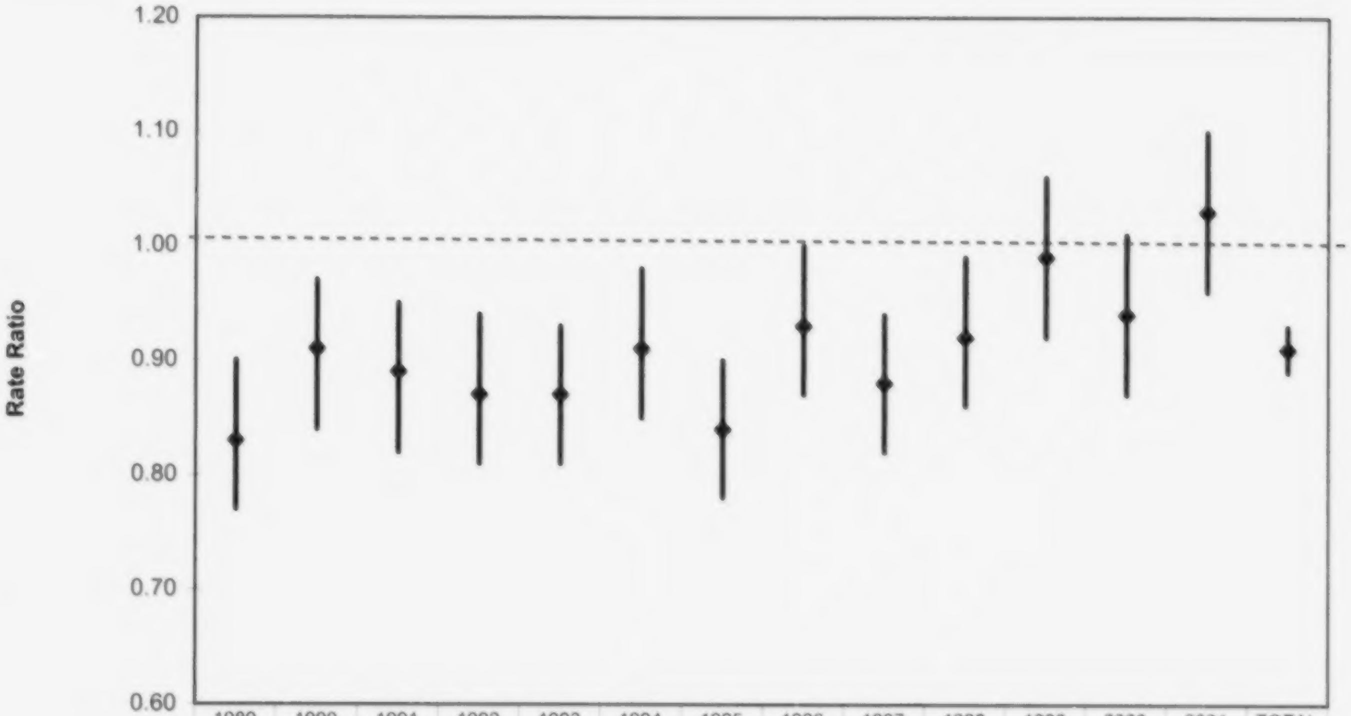
Figure 3.6: Rate ratios of live births for Health Regions 5&6 and New Brunswick Standard population, 1989-2001



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
95% LCL	0.86	0.87	0.85	0.83	0.79	0.81	0.79	0.71	0.84	0.76	0.73	0.77	0.74	0.84
95% UCL	0.96	0.97	0.95	0.93	0.89	0.91	0.89	0.81	0.95	0.86	0.83	0.88	0.85	0.87
◆ Rate Ratio	0.91	0.92	0.9	0.88	0.84	0.86	0.84	0.76	0.89	0.81	0.78	0.83	0.79	0.85

Year

Figure 3.7: Rate ratios for deaths for Health Regions 5&6 and Reference New Brunswick Standard Population, 1989-2001



	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	TOTAL
95% LCL	0.77	0.84	0.82	0.81	0.81	0.85	0.78	0.87	0.82	0.86	0.92	0.87	0.96	0.89
95% UCL	0.90	0.97	0.95	0.94	0.93	0.98	0.90	1.00	0.94	0.99	1.06	1.01	1.10	0.93
◆ Rate Ratio	0.83	0.91	0.89	0.87	0.87	0.91	0.84	0.93	0.88	0.92	0.99	0.94	1.03	0.91

Year

Table 3.6: Low birth weight by year for Health Regions 5 and 6 (HR 5&6) and New Brunswick Standard Population, 1989-2001

Year	Health Regions 5 & 6				New Brunswick Standard Population				Rate Ratio	95% LCL	95% UCL	P value
	Birth Weight			Rate*	Birth Weight			Rate*				
	Total births (%)	< 2,500 g (%)	≥ 2,500 g (%)		Total births (%)	< 2,500 g (%)	≥ 2,500 g (%)					
1989	1,485 (9.41)	89 (10.36)	1,396 (9.36)	59.93	8,166 (8.58)	472 (9.32)	7,694 (8.54)	57.80	1.04	0.80	1.27	0.79
1990	1,524 (9.66)	90 (10.48)	1,434 (9.61)	59.06	8,294 (8.72)	410 (8.09)	7,884 (8.75)	49.43	1.19	0.92	1.47	0.13
1991	1,451 (9.20)	78 (9.08)	1,373 (9.20)	53.76	8,042 (8.45)	447 (8.83)	7,595 (8.43)	55.58	0.97	0.73	1.20	0.73
1992	1,400 (8.87)	73 (8.50)	1,327 (8.89)	52.14	7,985 (8.39)	435 (8.59)	7,550 (8.38)	54.48	0.96	0.72	1.19	0.67
1993	1,293 (8.19)	67 (7.80)	1,226 (8.22)	51.82	7,748 (8.14)	433 (8.55)	7,315 (8.12)	55.89	0.93	0.69	1.17	0.51
1994	1,297 (8.22)	73 (8.50)	1,224 (8.20)	56.28	7,668 (8.06)	456 (9.00)	7,212 (8.00)	59.47	0.95	0.71	1.18	0.61
1995	1,203 (7.62)	64 (7.45)	1,139 (7.63)	53.20	7,353 (7.73)	344 (6.79)	7,009 (7.78)	46.78	1.14	0.83	1.44	0.37
1996	1,044 (6.62)	50 (5.82)	994 (6.66)	47.89	7,128 (7.49)	370 (7.31)	6,758 (7.50)	51.91	0.92	0.65	1.20	0.53
1997	1,162 (7.36)	65 (7.57)	1,097 (7.35)	55.94	6,745 (7.09)	353 (6.97)	6,392 (7.09)	52.34	1.07	0.79	1.35	0.66
1998	1,054 (6.68)	51 (5.94)	1,003 (6.72)	48.39	6,814 (7.16)	371 (7.32)	6,443 (7.15)	54.45	0.89	0.63	1.15	0.37

*Note: *Rates shown for low births weights are crude rates per 1,000 births. Populations from census years (1991, 1996, 2001) otherwise they are inter-censal estimates obtained from New Brunswick Health and Wellness.*

Table 3.6 (cont'd): Low birth weight by year for Health Regions 5 and 6 (HR 5&6) and New Brunswick Standard Population, 1989-2001

Year	Health Regions 5 & 6				New Brunswick Standard Population				Rate Ratio	95% LCL	95% UCL	P value
	Birth Weight			Rate*	Birth Weight			Rate*				
	Total births (%)	< 2,500 g (%)	≥ 2,500 g (%)		Total births (%)	< 2,500 g (%)	≥ 2,500 g (%)					
1999	979 (6.20)	55 (6.40)	924 (6.19)	56.18	6,626 (6.96)	364 (7.19)	6,262 (6.95)	54.94	1.02	0.73	1.31	0.92
2000	982 (6.22)	49 (5.70)	933 (6.25)	49.90	6,358 (6.68)	295 (5.82)	6,063 (6.73)	46.40	1.08	0.75	1.40	0.67
2001	905 (5.74)	55 (6.40)	850 (5.70)	60.77	6,236 (6.55)	315 (6.22)	5,921 (6.57)	50.51	1.20	0.86	1.55	0.22
TOTAL	15,779 (100.00)	859 (100.00)	14,920 (100.00)	54.44	95,163 (100.00)	5,065 (100.00)	90,098 (100.00)	53.22	1.02	0.95	1.10	0.54

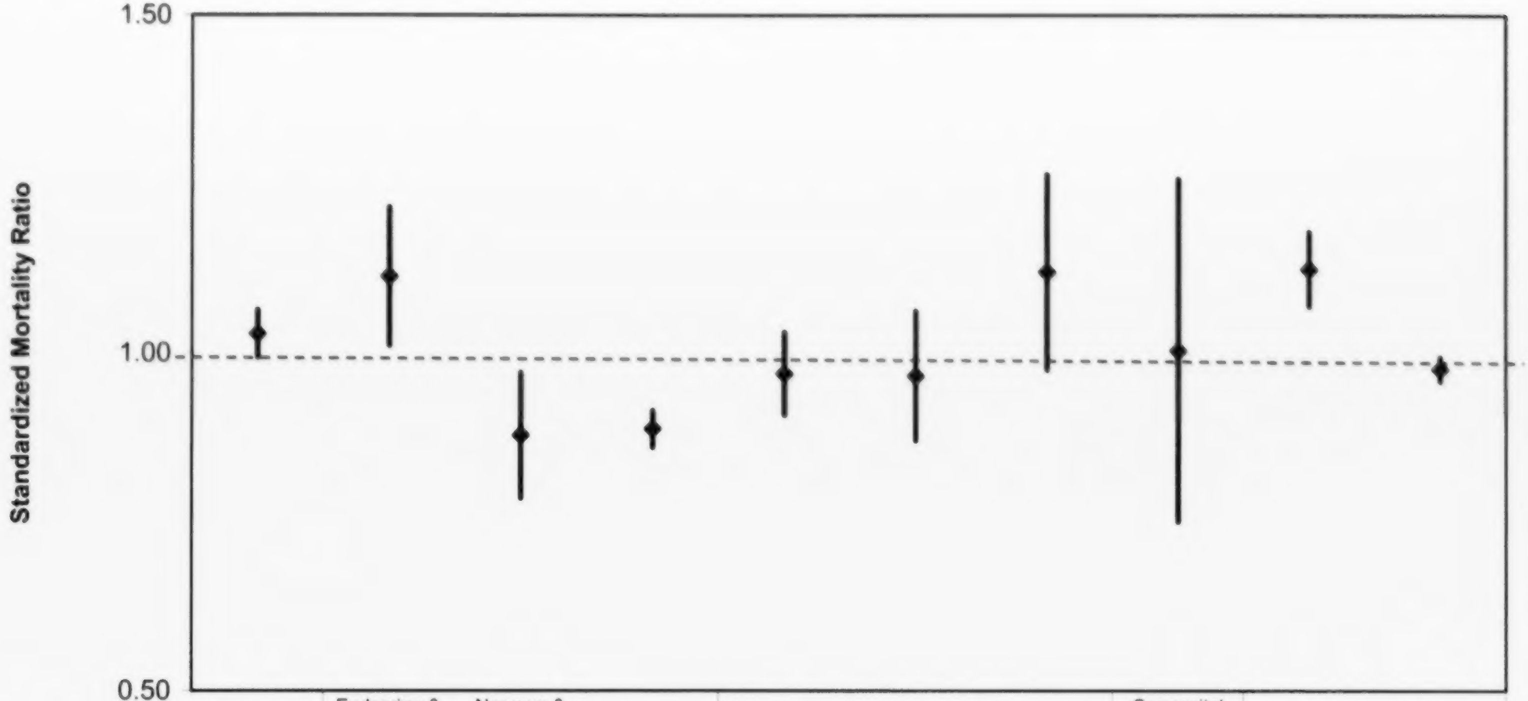
*Note: *Rates shown for low births weights are crude rates per 1,000 births. Populations from census years (1991, 1996, 2001) otherwise they are inter-censal estimates obtained from New Brunswick Health and Wellness.*

Table 3.7: Congenital anomalies (ICD-9:740-759) by year for Greater Belledune Area (GBA) and New Brunswick Standard Population, 1989-2001

Year	Health Regions 5 and 6			New Brunswick Standard Population			Rate Ratio	95% LCL	95% UCL	P value
	Total births (%)	Congenital Anomalies	Rate*	Total births (%)	Congenital Anomalies	Rate*				
1989	1,485 (9.41)	8 (12.90)	5.39	8,166 (8.58)	43 (11.08)	5.27	1.02	0.25	1.80	0.89
1990	1,524 (9.66)	**	**	8,294 (8.72)	24 (6.19)	2.89	0.91	0.00	1.87	**
1991	1,451 (9.20)	**	**	8,042 (8.45)	34 (8.76)	4.23	1.14	0.21	2.07	**
1992	1,400 (8.87)	7 (11.29)	5.00	7,985 (8.39)	41 (10.57)	5.13	0.97	0.19	1.75	0.79
1993	1,293 (8.19)	**	**	7,748 (8.14)	56 (14.43)	7.23	0.43	0.00	0.86	**
1994	1,297 (8.22)	12 (19.35)	9.25	7,668 (8.06)	30 (7.73)	3.91	2.36	0.78	3.95	0.01
1995	1,203 (7.62)	**	**	7,353 (7.73)	37 (9.54)	5.03	0.66	0.00	1.34	**
1996	1,044 (6.62)	6 (9.68)	5.75	7,128 (7.49)	34 (8.76)	4.77	1.20	0.16	2.25	0.86
1997	1,162 (7.36)	**	**	6,745 (7.09)	24 (6.19)	3.56	1.21	0.04	2.37	**
1998	1,054 (6.68)	**	**	6,814 (7.16)	18 (4.64)	2.64	0.36	0.00	1.08	**
1999	979 (6.20)	**	**	6,626 (6.96)	15 (3.87)	2.26	1.35	0.00	3.03	**
2000	982 (6.22)	**	**	6,358 (6.68)	18 (4.64)	2.83	0.36	0.00	1.08	**
2001	905 (5.74)	0 (0.00)	0.00	6,236 (6.55)	14 (3.61)	2.25	0.00	0.00	0.00	0.07
TOTAL	15,779 (100.00)	62 100.00)	3.93	95,163 (100.00)	388 (100.00)	4.08	0.96	0.71	1.22	0.74

*Note: *Rates shown for congenital anomalies are crude rates per 1,000 births. Populations from census years (1991, 1996, 2001) otherwise they are inter-censal estimates obtained from New Brunswick Health and Wellness. ** Data suppressed due to small number of observed events.*

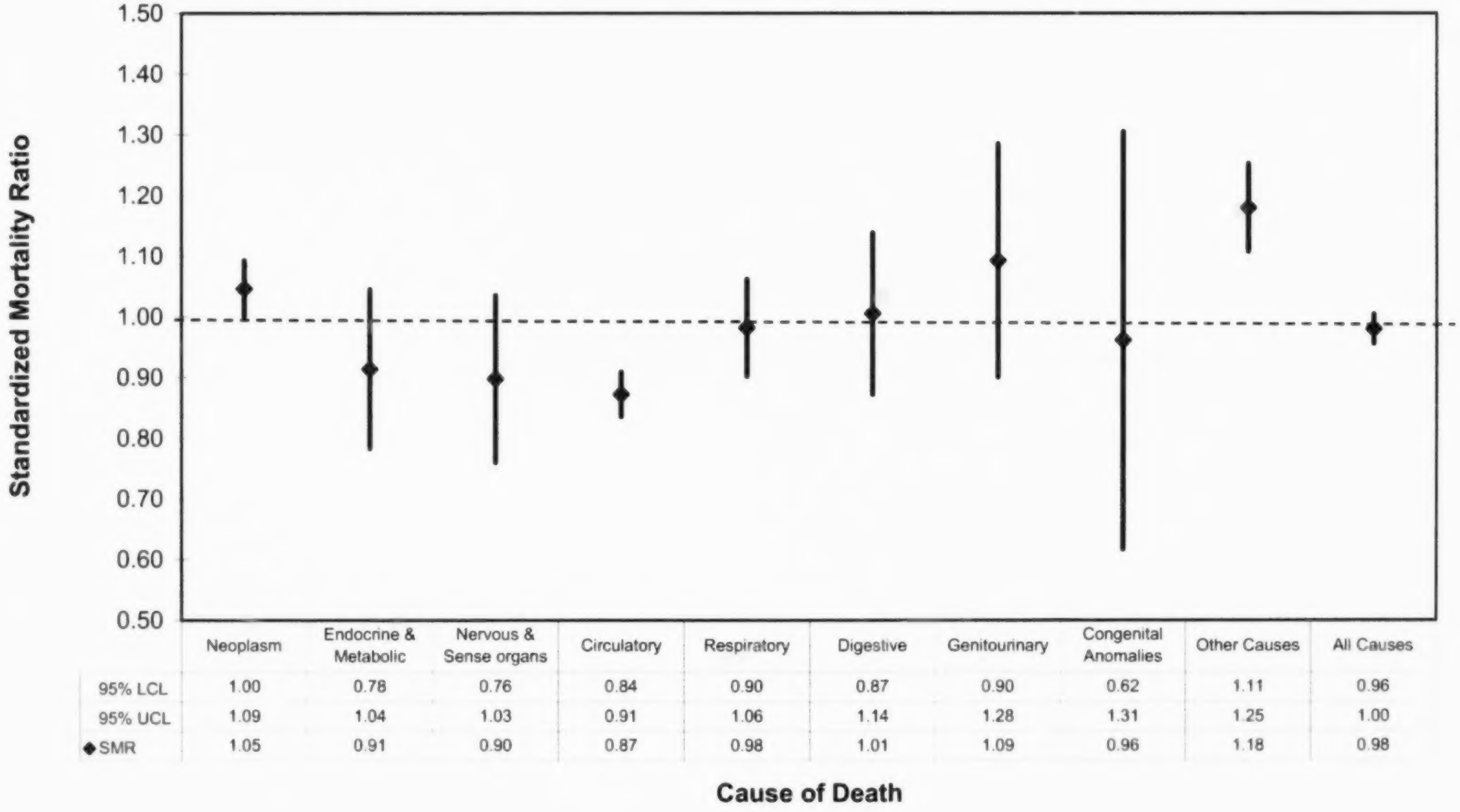
Figure 3.8 Standardized mortality ratios for selected caused of death for Health Regions 5&6 for males and females combined, 1989-2001.



	Neoplasm	Endocrine & Metabolic	Nervous & Sense organs	Circulatory	Respiratory	Digestive	Genitourinary	Congenital Anomalies	Other Causes	All Causes
95% LCL	0.99	1.01	0.78	0.86	0.91	0.87	0.97	0.75	1.07	0.96
95% UCL	1.06	1.22	0.97	0.91	1.03	1.06	1.26	1.26	1.18	0.99
◆ SMR	1.03	1.11	0.88	0.89	0.97	0.97	1.12	1.00	1.12	0.98

Cause of Death

Figure 3.9: Standardized mortality ratios for selected caused of death for Health Regions 5&6 for males, 1989-2001.



	Neoplasm	Endocrine & Metabolic	Nervous & Sense organs	Circulatory	Respiratory	Digestive	Genitourinary	Congenital Anomalies	Other Causes	All Causes
95% LCL	1.00	0.78	0.76	0.84	0.90	0.87	0.90	0.62	1.11	0.96
95% UCL	1.09	1.04	1.03	0.91	1.06	1.14	1.28	1.31	1.25	1.00
◆ SMR	1.05	0.91	0.90	0.87	0.98	1.01	1.09	0.96	1.18	0.98

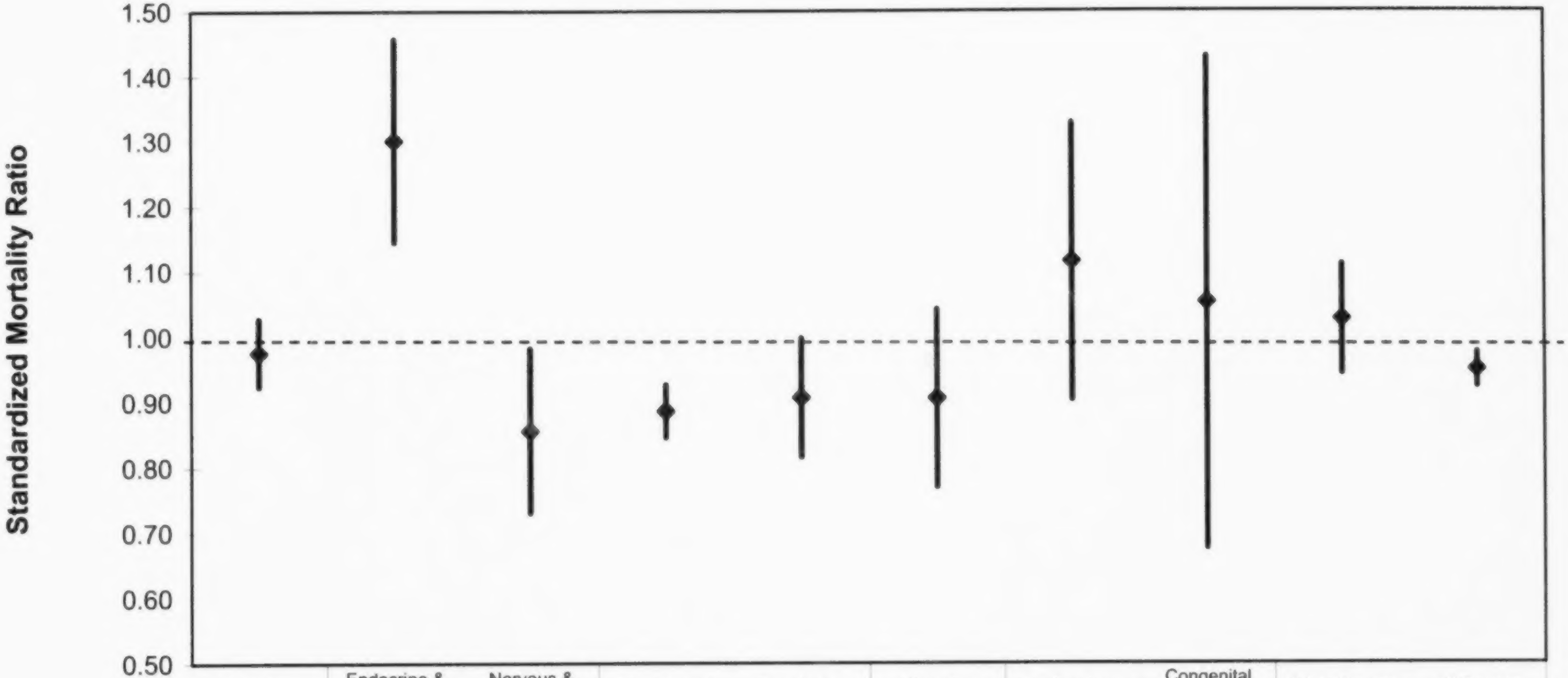


Figure 3.10: Standardized mortality ratios for selected caused of death for Health Regions 5&6 for females, 1989-2001.

	Neoplasm	Endocrine & Metabolic	Nervous & Sense organs	Circulatory	Respiratory	Digestive	Genitourinary	Congenital Anomalies	Other Causes	All Causes
95% LCL	0.92	1.15	0.73	0.85	0.82	0.77	0.90	0.68	0.94	0.92
95% UCL	1.03	1.46	0.98	0.93	1.00	1.04	1.33	1.43	1.11	0.98
◆ SMR	0.98	1.30	0.86	0.89	0.91	0.91	1.12	1.05	1.03	0.95

Cause of Death

4.0 Cancer Incidence

Cancer incidence is the occurrence of a new case of malignant cancer in a given period. Cancer was one main health concern consistently identified in the community consultations and was also related to exposure to some of the COPC identified in the HHRA component of the study.

4.1 Registry data

As previously described, the data source for this set of analyses was the NB cancer registry for the years 1989-2001 inclusive. The initial step involved data cleaning and validating the data with external reports. All investigations indicated that the data was of high quality. The few exceptions that were removed for the present analyses included:

- 226 of 42,627 cases had missing ICD-9 or ICD-10 codes
- 284 of 42,627 cases had a behavior code that did not match their ICD code (e.g., malignant vs. benign).

This left 42,119 out of 42,627 cases that were used for the analyses.

The focus of the analyses for this study was on primary malignant or invasive cancer sites. Non-malignant skin cancer is not included in the NB registry, and was not included in this study.

It should also be noted that more recent years of the time period used ICD-10 codes. These were converted to ICD-9 codes to be consistent with the earlier years.

4.2 Findings

4.2.2 General descriptive

Table 4.1 shows the distribution of newly diagnosed cancer cases by year and geographical area for the province of New Brunswick. Between 1989 and 2001, there were 42,119 newly diagnosed malignant cases cancer (ICD-9: 140-208) in New Brunswick. Of these, 450 cases (1%) were from the Greater Belledune Area and 6,540 cases (16%) from Health Regions 5&6. In all three geographical areas (GBA, HR 5&6, and NB), more males were diagnosed with cancer than females.

Table 4.1: Cancer incidence in New Brunswick by year and sex, 1989-2001

Year	Belledune		Heath Regions 5&6		All of NB	
	Males	Females	Males	Females	Males	Females
1989	17	7	230	164	1,497	1,192
1990	14	13	246	169	1,519	1,298
1991	18	13	236	198	1,477	1,300
1992	23	12	297	192	1,754	1,358
1993	21	11	265	207	1,863	1,476
1994	16	13	292	225	1,909	1,477
1995	17	7	305	204	1,746	1,415
1996	22	13	289	226	1,767	1,479
1997	19	14	274	253	1,832	1,589
1998	31	11	357	222	1,848	1,629
1999	19	11	307	253	1,937	1,662
2000	22	14	328	234	1,831	1,612
2001	15	12	338	229	1,973	1,679
Total	254	151	3,764	2,776	22,953	19,166

Sources: New Brunswick Cancer Registry

As expected, cancer is associated with age. As shown in Table 4.2, in all three geographical areas, the proportion of newly diagnosed cases of cancer was more common among those who were 50 years of age or older. Cancer among children and young adults (< 20 years of age) was rare. For example, for the entire study period (13 years), there were less than 10 cancer cases diagnosed for those less than 20 years of age in the Greater Belledune Area.

Table 4.3 describes cancer incidence by site and gender for the three geographical areas. Crude rates (per 100,000 populations per year) are also presented in this table. For males, prostate (ICD-9: 185) and respiratory (ICD-9: 160-165) cancers are most common. For females, breast (ICD-9: 174) and respiratory cancers are most commonly diagnosed malignancy.

Table 4.2: Cancer incidence in New Brunswick by age and sex, 1989-2001

Age Groups (Years)	Belledune		Heath Regions 5&6		All of NB	
	Males (%)	Females (%)	Males (%)	Females (%)	Males (%)	Females (%)
0-9	**	**	15 (` 0.40)	12 (0.43)	101 (0.44)	84 (0.44)
10-19	**	**	21 (0.56)	18 (0.65)	120 (0.52)	98 (0.51)
20-29	**	**	37 (0.98)	59 (2.13)	219 (0.95)	302 (1.58)
30-39	**	7 (4.64)	69 (1.83)	142 (5.12)	433 (1.89)	874 (4.56)
40-49	22 (8.66)	19 (12.58)	220 (5.84)	374 (13.47)	1,283 (5.59)	2,079 (10.85)
50-59	43 (16.93)	28 (18.54)	571 (15.17)	501 (18.05)	3,162 (13.78)	3,094 (16.14)
60-69	71 (27.95)	26 (17.22)	1,059 (28.13)	576 (20.75)	6,545 (28.51)	4,288 (22.37)
70-79	74 (29.13)	41 (27.15)	1,175 (31.22)	640 (23.05)	7,495 (32.65)	5,016 (26.17)
80+	37 (14.57)	22 (14.57)	597 (15.86)	454 (16.35)	3,595 (15.66)	3,331 (17.38)
Total	254 (100.00)	151 (100.00)	3,764 (100.00)	2,776 (100.00)	22,953 (100.00)	19,166 (100.00)

*Sources: New Brunswick Cancer Registry ** Data suppressed due to small number of observed events.*

Table 4.3: Cancer incidence in New Brunswick by major cancer sites and sex, 1989-2001

Cancer Site (ICD-9 Code)	Greater Belledune Area				Heath Regions 5&6				All of NB			
	Male		Females		Male		Females		Male		Females	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Lip, oral cavity, and pharynx (140-149)	14 (5.51)	41.48	**	**	111 (2.95)	14.03	45 (1.62)	5.69	662 (2.88)	13.73	223 (1.16)	4.54
Oesophagus (150)	0 (0.00)	0.00	**	**	33 (0.88)	4.17	8 (0.29)	1.01	247 (1.08)	5.12	106 (0.55)	2.16
Stomach (151)	18 (7.09)	53.33	6 (3.97)	17.72	173 (4.60)	21.87	86 (3.10)	10.87	687 (2.99)	14.25	365 (1.90)	7.44
Small intestine, including duodenum (152)	**	**	0 (0.00)	0.00	8 (0.21)	1.01	10 (0.36)	1.26	65 (0.28)	1.35	49 (0.26)	1.00
Colon (153)	15 (5.91)	44.44	16 (10.60)	47.25	243 (6.46)	30.72	216 (7.78)	27.30	1,881 (8.20)	39.03	1,966 (10.26)	40.07
Rectum, rectosigmoid junction and anus (154)	10 (3.94)	29.63	11 (7.28)	32.48	202 (5.37)	25.54	150 (5.40)	18.96	1,034 (4.50)	21.45	731 (3.81)	14.90
Liver and intra-hepatic bile ducts (155)	**	**	0 (0.00)	0.00	18 (0.48)	2.28	21 (0.76)	2.65	151 (0.66)	3.13	73 (0.38)	1.49
Gallbladder and extra-hepatic bile ducts (156)	**	**	**	**	13 (0.35)	1.64	18 (0.65)	2.27	86 (0.37)	1.78	128 (0.67)	2.61
Pancreas (157)	**	**	**	**	91 (2.42)	11.50	88 (3.17)	11.12	519 (2.26)	10.77	517 (2.70)	10.54
Digestive system (other and unspecified, 158,159)	**	**	0 (0.00)	0.00	8 (0.21)	1.01	12 (0.43)	1.52	64 (0.28)	1.33	96 (0.50)	1.96
Respiratory (trachea, lung) and intra-thoracic organs (160-165)	67 (26.38)	198.49	23 (15.23)	67.91	867 (23.03)	109.61	340 (12.25)	42.97	5,073 (22.10)	105.25	2,449 (12.78)	49.91
Bone, connective tissue and skin (170-173, 176)	**	**	10 (6.62)	29.53	124 (3.29)	15.68	92 (3.31)	11.63	887 (3.86)	18.40	837 (4.37)	17.06
Breast (174, 175)	**	**	33 (21.85)	97.44	6 (0.16)	0.76	791 (28.49)	99.97	36 (0.16)	0.75	5,566 (29.04)	113.44
Female genital organ (other) (179, 181, 184)	0 (0.00)	0.00	**	**	0 (0.00)	0.00	30 (1.08)	3.79	0 (0.00)	0.00	193 (1.01)	3.93
Female genital organ (cervix) (180)	0 (0.00)	0.00	**	**	0 (0.00)	0.00	95 (3.42)	12.01	0 (0.00)	0.00	465 (2.43)	9.48
Female genital organ (Corpus uteri) (182)	0 (0.00)	0.00	6 (3.97)	17.72	0 (0.00)	0.00	111 (4.00)	14.03	0 (0.00)	0.00	918 (4.79)	18.71
Ovary and other uterine adnexa (183)	0 (0.00)	0.00	**	**	0 (0.00)	0.00	97 (3.49)	12.26	0 (0.00)	0.00	626 (3.27)	12.76
Prostate (185)	63 (24.80)	186.64	0 (0.00)	0.00	1,001 (26.59)	126.55	0 (0.00)	0.00	6,109 (26.62)	126.75	0 (0.00)	0.00

Cancer Site (ICD-9 Code)	Greater Belledune Area				Heath Regions 5&6				All of NB			
	Male		Females		Male		Females		Male		Females	
	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate	N (%)	Rate
Testis (186)	**	**	0 (0.00)	0.00	21 (0.56)	2.65	0 (0.00)	0.00	168 (0.73)	3.49	0 (0.00)	0.00
Male genital organs (other) (187)	0 (0.00)	0.00	0 (0.00)	0.00	10 (0.27)	1.26	0 (0.00)	0.00	65 (0.28)	1.35	0 (0.00)	0.00
Bladder (188)	11 (4.33)	32.59	**	**	219 (5.82)	27.69	60 (2.16)	7.58	1,391 (6.06)	28.86	470 (2.45)	9.58
Kidney, other, and unspecified urinary organs (189)	9 (3.54)	26.66	6 (3.97)	17.72	135 (3.59)	17.07	95 (3.42)	12.01	787 (3.43)	16.33	573 (2.99)	11.68
Eye (190)	0 (0.00)	0.00	0 (0.00)	0.00	6 (0.16)	0.76	**	**	41 (0.18)	0.85	35 (0.18)	0.71
Brain and central nervous system (191,192)	**	**	**	**	68 (1.81)	8.60	39 (1.40)	4.93	374 (1.63)	7.76	290 (1.51)	5.91
Thyroid gland (193)	**	**	**	**	18 (0.48)	2.28	72 (2.59)	9.10	103 (0.45)	2.14	333 (1.74)	6.79
Other endocrine (194)	0 (0.00)	0.00	0 (0.00)	0.00	6 (0.16)	0.76	6 (0.22)	0.76	23 (0.10)	0.48	20 (0.10)	0.41
Ill-defined and primary sites unknown (195-199)	9 (3.54)	26.66	6 (3.97)	17.72	76 (2.02)	9.61	67 (2.41)	8.47	604 (2.63)	12.53	599 (3.13)	12.21
Lymphoma (other) (200, 202)	9 (3.54)	26.66	**	11.81	164 (4.36)	20.73	112 (4.03)	14.15	943 (4.11)	19.56	837 (4.37)	17.06
Hodgkin's disease (201)	0 (0.00)	0.00	**	2.95	17 (0.45)	2.15	13 (0.47)	1.64	130 (0.57)	2.70	102 (0.53)	2.08
Multiple myeloma (203)	**	5.93	**	2.95	35 (0.93)	4.42	26 (0.94)	3.29	272 (1.19)	5.64	210 (1.10)	4.28
Leukemia (204-208)	8 (3.15)	23.70	**	5.91	91 (2.42)	11.50	71 (2.56)	8.97	551 (2.40)	11.43	389 (2.03)	7.93
All Cancers (140-208)	254 (100.00)	752.48	151 (100.00)	445.87	3,764 (100.00)	475.87	2,776 (100.00)	350.83	22,953 (100.00)	476.22	19,166 (100.00)	390.62

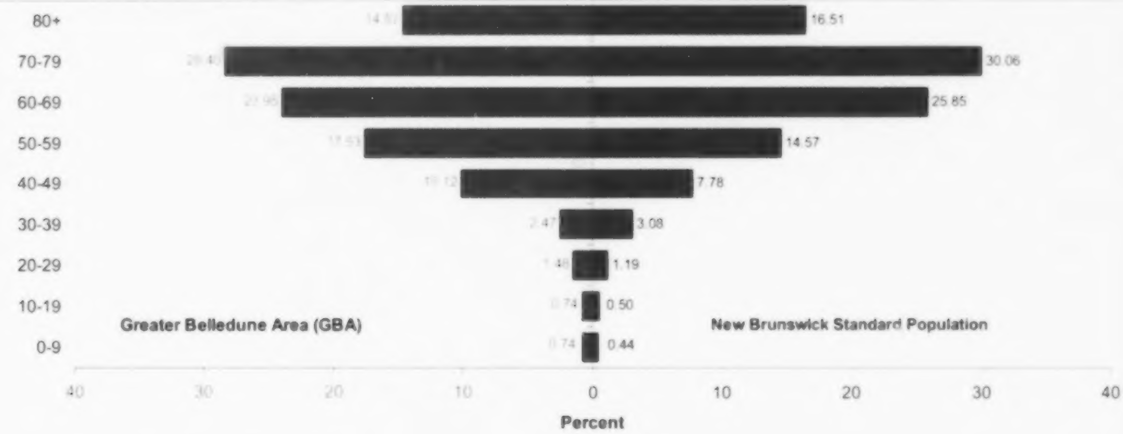
*Sources: New Brunswick Cancer Registry ** Data suppressed due to small number of observed events.*

4.2.2 Comparisons between GBA and the NB Standard

All Cancers (ICD-9: 140-208)

Between 1989 and 2001, there were 405 cases of malignant cancers (ICD-9:140-208, excluding non-melanotic skin) diagnosed among residents of the Greater Belledune Area for both males and females combined. Figure 4.1 shows that most of these cases are distributed among those who were 50 years of age or older. The most frequently diagnosed cancer (Table 4.4) was respiratory and intra-thoracic organs (ICD-9: 160-165, 90 cases or 22%). On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 64.15 and 66.09 years for residents of GBA and the comparison population respectively, a statistically significant difference of 1.94 years (p = 0.01). Overall, the incidence of all cancers in the GBA was higher that expected (n=297). The SIR showed that there was a statistically significant excess in cancer diagnosis in the GBA for all cancers (ICD-9: 140-208) when using rates generated from the New Brunswick standard population (SIR = 1.35, 95% CI: 1.23-1.50).

Figure 4.1: Percent distribution of cancer incidence (all cancers, ICD-9: 140-208) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 64.15 years*
- *New Brunswick Standard Population: 66.09 years*
- *Difference: -1.94 years (t-test: p = 0.01)*

Table 4.4: Percent distribution of cancer incidence by site by geographic area, 1989-2001

Greater Belledune Area (%)	Cancer Site Descriptions (ICD-9)	New Brunswick Standard Population (%)
19 (4.69)	Lip, oral cavity, and pharynx (140-149)	729 (2.05)
**	Oesophagus (150)	312 (0.88)
24 (5.93)	Stomach (151)	793 (2.23)
**	Small intestine, including duodenum (152)	96 (0.27)
31 (7.65)	Colon (153)	3,388 (9.52)
21 (5.19)	Rectum, rectosigmoid junction and anus (154)	1,413 (3.97)
**	Liver and intra-hepatic bile ducts (155)	185 (0.52)
**	Gallbladder and extra-hepatic bile ducts (156)	183 (0.51)
6 (1.48)	Pancreas (157)	857 (2.41)
**	Digestive system (other and unspecified, 158,159)	140 (0.39)
90 (22.22)	Respiratory (trachea, lung) and intra-thoracic organs (160-165)	6,315 (17.75)
14 (3.46)	Bone, connective tissue and skin (170-173, 176)	1,508 (4.24)
34 (8.40)	Breast (174, 175)	4,805 (13.51)
**	Female genital organ (other) (179, 181, 184)	163 (0.46)
**	Female genital organ (cervix) (180)	370 (1.04)
6 (1.48)	Female genital organ (Corpus uteri) (182)	807 (2.27)
**	Ovary and other uterine adnexa (183)	529 (1.49)
63 (15.56)	Prostate (185)	5,108 (14.36)
**	Testis (186)	147 (0.41)
0 (0.00)	Male genital organs (other) (187)	55 (0.15)
12 (2.96)	Bladder (188)	1,582 (4.45)
15 (3.70)	Kidney, other, and unspecified urinary organs (189)	1,130 (3.18)
0 (0.00)	Eye (190)	65 (0.18)
**	Brain and central nervous system (191,192)	557 (1.57)
**	Thyroid gland (193)	346 (0.97)
0 (0.00)	Other endocrine (194)	31 (0.09)
15 (3.70)	Ill-defined and primary sites unknown (195-199)	1,060 (2.98)
13 (3.21)	Lymphoma (other) (200, 202)	1,504 (4.23)
**	Hodgkin's disease (201)	202 (0.57)
**	Multiple myeloma (203)	421 (1.18)
10 (2.47)	Leukemia (204-208)	778 (2.19)
405	**Total**	**35,579**

*Sources: New Brunswick Cancer Registry ** Data suppressed due to small number of observed events.*

Table 4.5: Standardized incidence ratio (SIR) for all cancers (ICD-9: 140-208) for the Greater Belledune Area (GBA), 1989-2001.

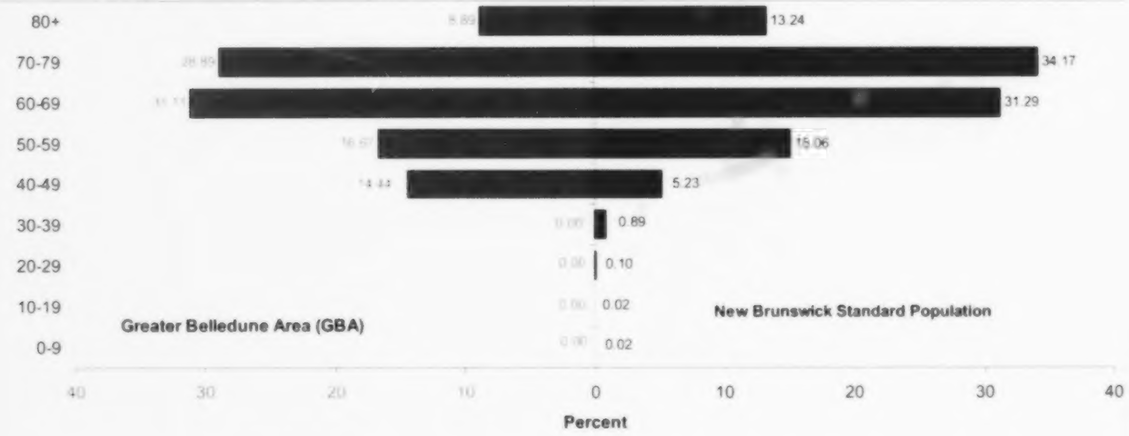
*** Data suppressed due to small number of observed events*

Age-Group (Years)	Observed Cancers for GBA	Expected number of all cancers	Ratio
0-9	**	1.13	**
10-19	**	1.54	**
20-29	6	3.15	1.90
30-39	10	9.00	1.11
40-49	41	26.48	1.55
50-59	71	47.59	1.49
60-69	97	80.11	1.21
70-79	115	88.49	1.30
80+	59	39.38	1.50
Total	405	296.88	1.36
SIR =	1.36		
95% LCL =	1.23		
95% UCL =	1.50		
P-value	<0.01		

Respiratory (Lung, Trachea, and Intra-thoracic) Cancer (ICD-9: 160-165)

Between 1989 and 2001, there were 90 cases of malignant cancers of the respiratory system (ICD-9: 160-165) diagnosed among residents of the Greater Belledune Area for both males and females combined. Figure 4.2 shows that most of these cases are distributed among those who were 40 years of age or older. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 64.53 and 67.77 years for residents of GBA and the comparison population respectively, a difference of 3.24 years ($p = 0.05$). Overall, the incidence of respiratory cancer in the GBA was higher that expected (n=53). The SIR showed that there was a statistically significant excess in cancer diagnosis in the GBA for all cancers of the respiratory system (ICD-9: 160-165) when using rates generated from the New Brunswick standard population (SIR = 1.70, 95% CI: 1.35-2.05).

Figure 4.2: Percent distribution of incidence of respiratory cancer (ICD-9: 160-165) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 64.53 years*
- *New Brunswick Standard Population: 67.77 years*
- *Difference: -3.24 years (t-test: p = 0.05)*

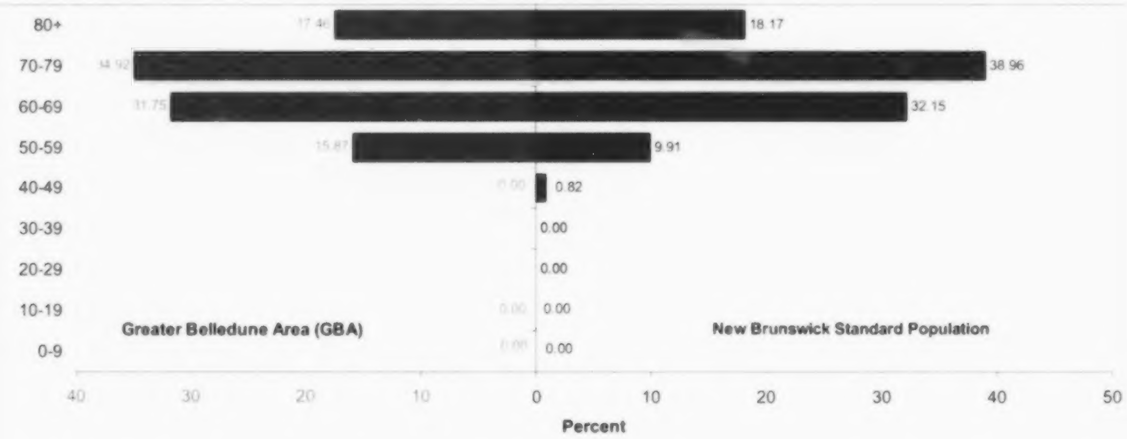
Table 4.6: Standardized incidence ratio (SIR) for respiratory cancer (ICD-9: 160-165) for the Greater Belledune Area (GBA), 1989-2001.

Age-Group (Years)	Observed Cancers for GBA	Expected number of for respiratory cancer	Ratio
0-9	0	0.01	0.00
10-19	0	0.01	0.00
20-29	0	0.04	0.00
30-39	0	0.46	0.00
40-49	13	3.16	4.12
50-59	15	8.73	1.72
60-69	28	17.21	1.63
70-79	26	17.85	1.46
80+	8	5.60	1.43
Total	90	53.08	1.70
SIR =	1.70		
95% LCL =	1.35		
95% UCL =	2.05		
P-value	<0.01		

Prostate Cancer (ICD-9: 185)

Between 1989 and 2001, there were 63 cases of malignant cancer of the prostate (ICD-9: 185) diagnosed among men living in the Greater Belledune Area. Figure 4.3 shows that all cases were 50 years of age or older. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 70.05 and 71.03 years for residents of GBA and the comparison population respectively, a difference of 0.98 years. However, the difference was not statistically significant (p = 0.40). Overall, the incidence of prostate cancer in the GBA was higher that expected (n=44). The SIR showed that there was a statistically significant excess in cancer diagnosis in the GBA for prostate cancer (ICD-9: 185) when using rates generated from the New Brunswick standard population (SIR = 1.44, 95% CI: 1.08-1.79).

Figure 4.3: Percent distribution of incidence of prostate cancer (ICD-9: 185) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 70.05 years*
- *New Brunswick Standard Population: 71.03 years*
- *Difference: -0.98 years (t-test: p = 0.40)*

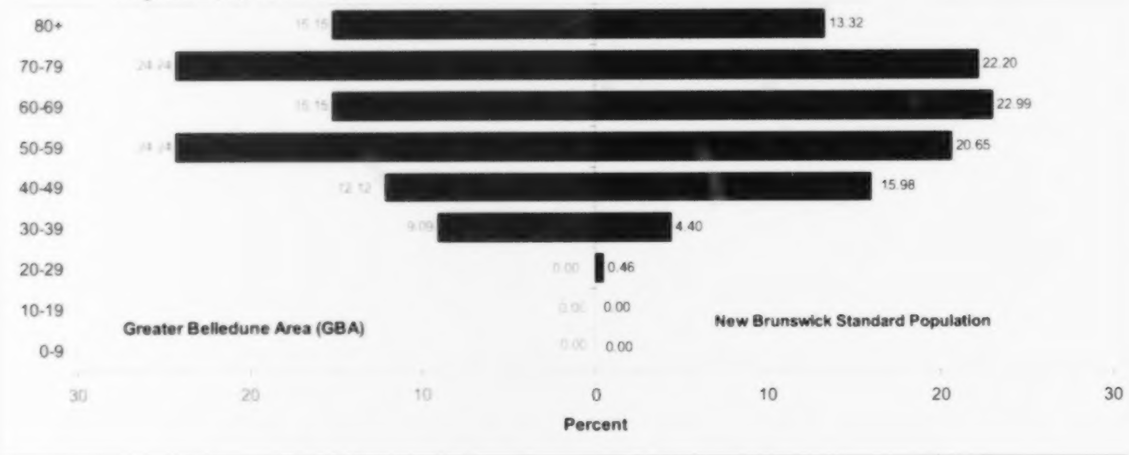
Table 4.7: Standardized incidence ratio (SIR) for prostate cancer (ICD-9: 185) for the Greater Belledune Area (GBA), 1989-2001

Age-Group (Years)	Observed Cancers for GBA	Expected number of prostate cancer	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	0.00	0.00
30-39	0	0.00	0.00
40-49	0	0.40	0.00
50-59	10	4.73	2.11
60-69	20	15.06	1.33
70-79	22	17.35	1.27
80+	11	6.25	1.76
Total	63	43.78	1.44
SIR =	1.44		
95% LCL =	1.08		
95% UCL =	1.79		
P-value	<0.01		

Breast Cancer (ICD-9: 174)

Between 1989 and 2001, there were 33 cases of malignant cancers of the breast (ICD-9: 174) diagnosed among women living in the Greater Belledune Area. Figure 4.4 shows that cases in the GBA were diagnosed between 30 and 80+ years of age. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 61.48 and 62.84 years for residents of GBA and the comparison population respectively, a difference of 1.36 years. However, the difference was not statistically significant (p = 0.59). Overall, the incidence of breast cancer in the GBA was lower that expected (n=40). The SIR showed that there was a non- statistically significant reduction in cancer diagnosis in the GBA for cancer of the female breast (ICD-9: 174) when using rates generated from the New Brunswick standard population (SIR = 0.83, 95% CI: 0.55-1.11).

Figure 4.4: Percent distribution of incidence of female breast cancer (ICD-9: 174) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 61.48 years*
- *New Brunswick Standard Population: 62.84 years*
- *Difference: -1.36 years (t-test: p = 0.59)*

Table 4.8: Standardized incidence ratio (SIR) for female breast cancer (ICD-9: 174) for the Greater Belledune Area (GBA), 1989-2001.

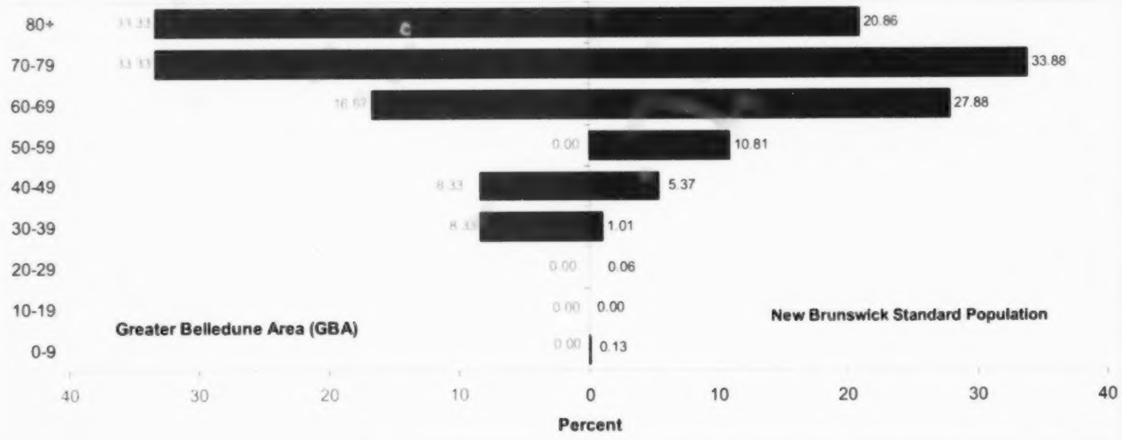
Age-Group (Years)	Observed Cancers for GBA	Expected number of female breast cancer	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	0.16	0.00
30-39	**	1.76	**
40-49	**	7.28	**
50-59	8	8.89	0.90
60-69	**	9.11	**
70-79	8	8.41	0.95
80+	**	4.25	**
Total	33	39.86	0.83
SIR =	0.83		
95% LCL =	0.55		
95% UCL =	1.11		
p-value	0.28		

*** Data suppressed due to small number of observed events*

Bladder Cancer (ICD-9: 188)

Between 1989 and 2001, there were 12 cases of malignant cancers of the bladder (ICD-9: 188) diagnosed among residents living in the Greater Belledune Area. Figure 4.5 shows that cases in the GBA were diagnosed between 30 and 80+ years of age. On average, residents of GBA were diagnosed later than the comparison population. The average age of diagnosis was 70.58 and 69.89 years for residents of GBA and the comparison population respectively, a difference of 0.69 years. This difference was not statistically significant (p = 0.84). Overall, the incidence of all bladder cancer in the GBA was lower than expected (n=13). The SIR showed that there was a non-significant reduction in bladder cancer (ICD-9: 188) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 0.92, 95% CI: 0.40-1.44).

Figure 4.5: Percent distribution of incidence of bladder cancer (ICD-9: 188) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 70.58 years*
- *New Brunswick Standard Population: 69.89 years*
- *Difference: 0.69 years (t-test: p = 0.84)*

Table 4.9: Standardized incidence ratio (SIR) for bladder cancer (ICD-9: 188) for the Greater Belledune Area (GBA), 1989-2001.

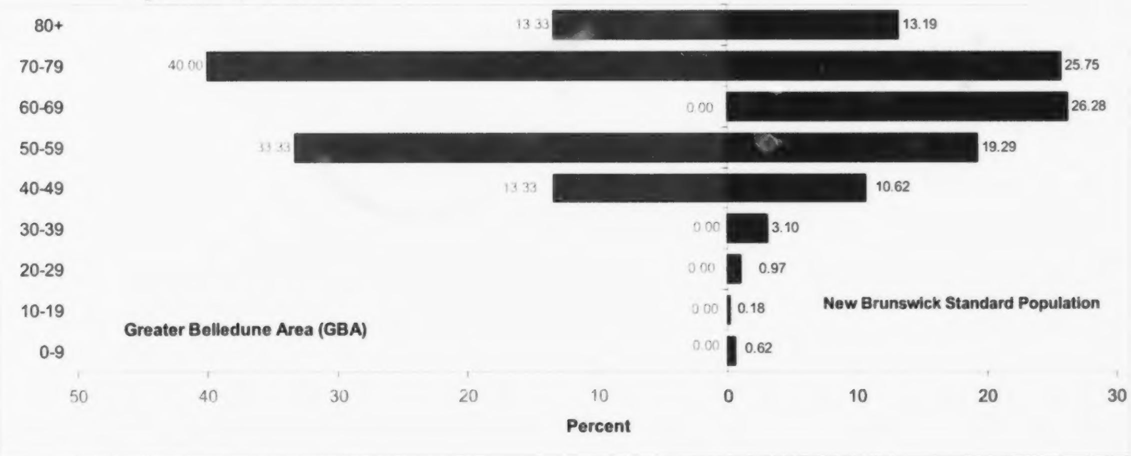
Age-Group (Years)	Observed Cancers for GBA	Expected number of bladder cancer	Ratio
0-9	0	0.01	0.00
10-19	0	0.00	0.00
20-29	0	0.01	0.00
30-39	**	0.13	**
40-49	**	0.81	**
50-59	0	1.57	0.00
60-69	**	3.84	**
70-79	**	4.43	**
80+	**	2.21	**
Total	12	13.02	0.92
SIR =	0.92		
95% LCL =	0.40		
95% UCL =	1.44		
p-value	0.77		

*** Data suppressed due to small number of observed events*

Cancer of the Kidney (ICD-9: 189)

Between 1989 and 2001, there were 15 cases of malignant cancers of the kidney (ICD-9: 189) diagnosed among residents living in the Greater Belledune Area. Figure 4.6 shows that cases in the GBA were diagnosed between 40 and 80+ years of age. On average, residents of GBA were diagnosed later than the comparison population. The average age of diagnosis was 65.68 and 64.15 years for residents of GBA and the comparison population respectively, a difference of 1.65 years. This difference was not statistically significant ($p = 0.66$). Overall, the incidence of all kidney cancer in the GBA was higher than expected (n=10). The SIR showed that there was a non-significant excess in kidney cancer (ICD-9: 189) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 1.57, 95% CI: 0.77-2.36).

Figure 4.6: Percent distribution of incidence of cancer of the kidney (ICD-9: 189) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 65.80 years*
- *New Brunswick Standard Population: 64.15 years*
- *Difference: 1.65 years (t-test: p = 0.66)*

Table 4.10: Standardized incidence ratio (SIR) for cancer of the kidney (ICD-9: 189) for the Greater Belledune Area (GBA), 1989-2001.

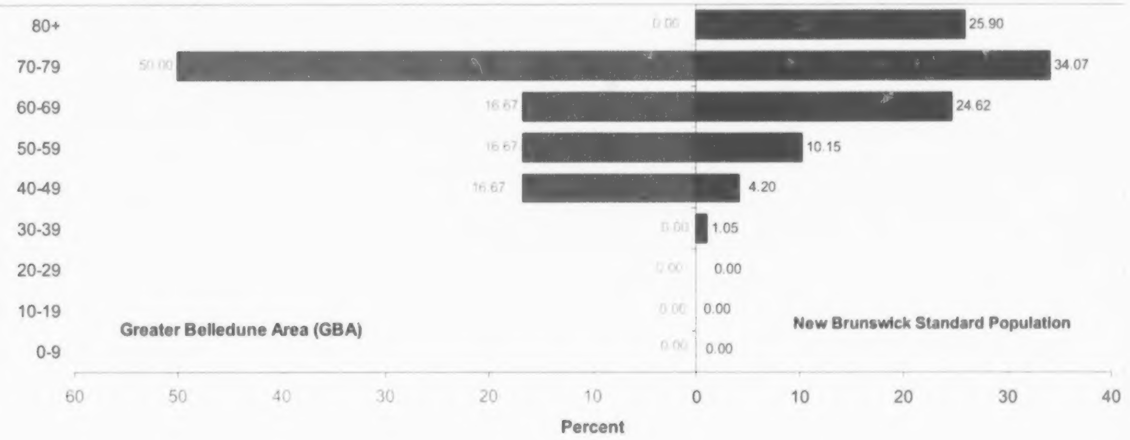
Age-Group (Years)	Observed Cancers for GBA	Expected number of kidney cancer	Ratio
0-9	0	0.05	0.00
10-19	0	0.02	0.00
20-29	0	0.08	0.00
30-39	0	0.29	0.00
40-49	**	1.15	**
50-59	**	2.00	**
60-69	0	2.59	0.00
70-79	6	2.41	2.49
80+	**	1.00	**
Total	15	9.58	1.57
SIR =	1.57		
95% LCL =	0.77		
95% UCL =	2.36		
p-value	0.08		

*** Data suppressed due to small number of observed events*

Pancreatic Cancer (ICD-9: 157)

Between 1989 and 2001, there were 6 cases of malignant cancers of the pancreas (ICD-9: 157) diagnosed among residents living in the Greater Belledune Area. Figure 4.7 shows that cases in the GBA were diagnosed between 40 and 79 years of age. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 61.67 and 71.16 years for residents of GBA and the comparison population respectively, a difference of 9.49 years. This difference was approached statistical significance at the 5% level (p = 0.05). Overall, the incidence of all pancreatic cancer in the GBA was lower than expected (n=7). The SIR showed that there was a non-significant reduction in pancreatic cancer (ICD-9: 157) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 0.86, 95% CI: 0.17-1.55).

Figure 4.7: Percent distribution of incidence of pancreatic cancer (ICD-9: 157) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 61.67 years*
- *New Brunswick Standard Population: 71.16 years*
- *Difference: -9.49 years (t-test: p = 0.05)*

Table 4.11: Standardized incidence ratio (SIR) for pancreatic cancer (ICD-9: 157) for the Greater Belledune Area (GBA), 1989-2001.

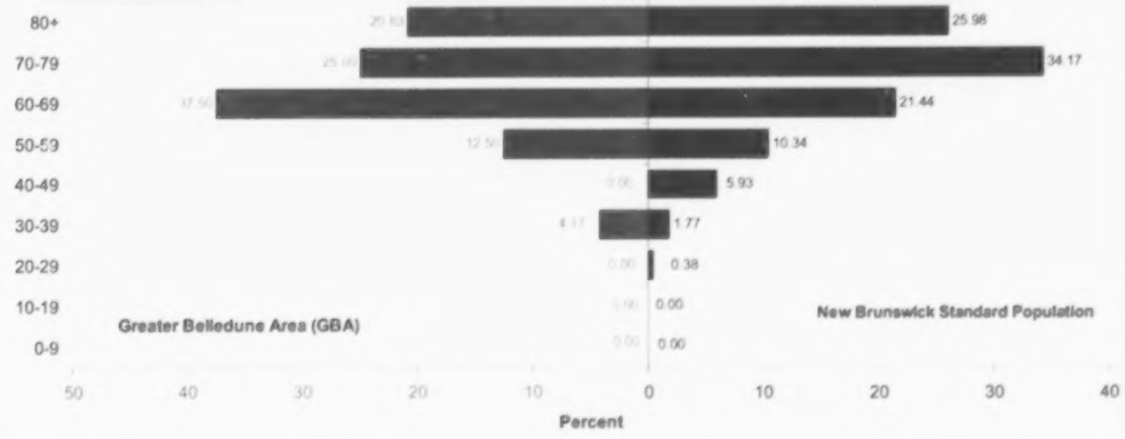
Age-Group (Years)	Observed Cancers for GBA	Expected number of pancreatic cancer	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	0.00	0.00
30-39	0	0.07	0.00
40-49	**	0.34	**
50-59	**	0.80	**
60-69	**	1.84	**
70-79	**	2.42	**
80+	0	1.49	0.00
Total	6	6.96	0.86
SIR =	0.86		
95% LCL =	0.17		
95% UCL =	1.55		
p-value	0.72		

*** Data suppressed due to small number of observed events*

Stomach Cancer (ICD-9: 151)

Between 1989 and 2001, there were 24 cases of malignant cancer of the stomach (ICD-9: 151) diagnosed among residents living in the Greater Belledune Area. Figure 4.8 shows that cases in the GBA were diagnosed between 30 and 80+ years of age. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 68.58 and 70.56 years for residents of GBA and the comparison population respectively, a difference of 1.98 years. This difference was not statistically significant (p = 0.46). Overall, the incidence of all stomach cancer in the GBA was higher than expected (n=6). The SIR showed that there was an excess of stomach cancer (ICD-9: 151) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 3.72, 95% CI: 2.23-5.22).

Figure 4.8: Percent distribution of incidence of stomach cancer (ICD-9: 151) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 68.58 years*
- *New Brunswick Standard Population: 70.56 years*
- *Difference: -1.98 years (t-test: p = 0.46)*

Table 4.12: Standardized incidence ratio (SIR) for stomach cancer (ICD-9: 151) for the Greater Belledune Area (GBA), 1989-2001.

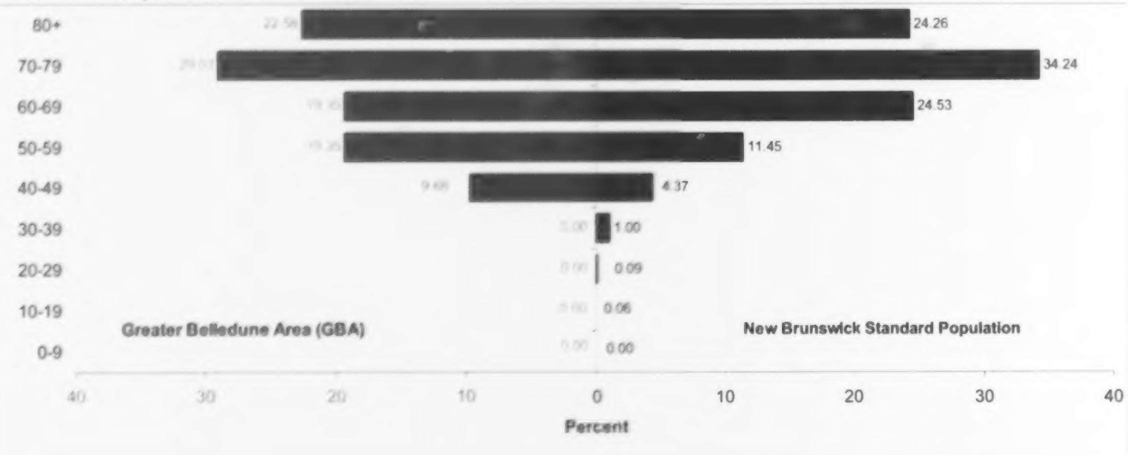
Age-Group (Years)	Observed Cancers for GBA	Expected number of stomach cancer	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	0.02	0.00
30-39	**	0.11	**
40-49	0	0.45	0.00
50-59	**	0.75	**
60-69	9	1.48	6.08
70-79	6	2.24	2.68
80+	**	1.38	**
Total	24	6.44	3.72
SIR =	3.72		
95% LCL =	2.23		
95% UCL =	5.22		
p-value	<0.01		

*** Data suppressed due to small number of observed events*

Colorectal Cancer (ICD-9: 153-154)

Between 1989 and 2001, there were 31 cases of malignant cancer of the colorectal (ICD-9: 153-154) diagnosed among residents living in the Greater Belledune Area. Figure 4.9 shows that cases in the GBA were diagnosed between 40 and 80+ years of age. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 68.23 and 70.77 years for residents of GBA and the comparison population respectively, a difference of 2.54 years. This difference was not statistically significant (p = 0.24). Overall, the incidence of colorectal cancer in the GBA was higher than expected (n=28). The SIR showed that there was an excess of colorectal cancer (ICD-9: 153-154) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 1.12, 95% CI: 0.73-1.52).

Figure 4.9: Percent distribution of incidence of colorectal cancer (ICD-9: 153-154) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 68.23 years*
- *New Brunswick Standard Population: 70.77 years*
- *Difference: -2.54 years (t-test: p = 0.24)*

Table 4.13: Standardized incidence ratio (SIR) for colorectal cancer (ICD-9: 153-154) for the Greater Belledune Area (GBA), 1989-2001.

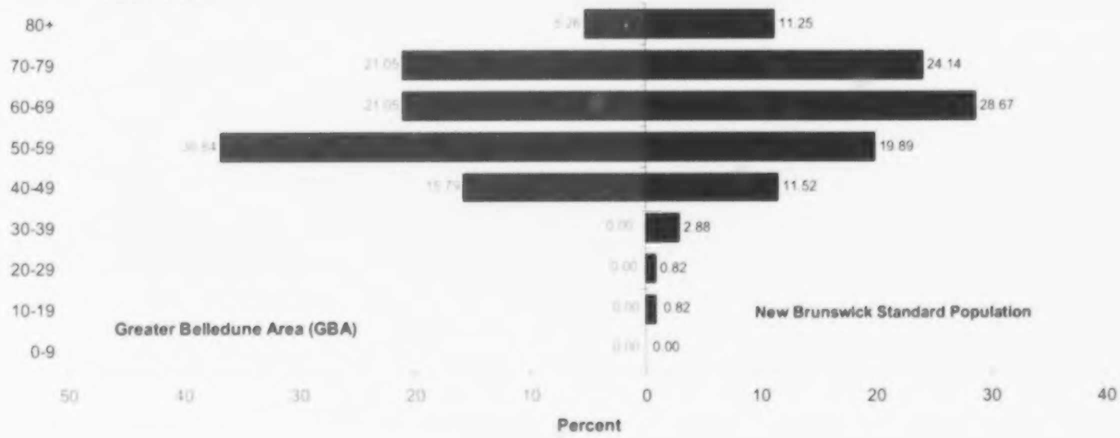
Age-Group (Years)	Observed Cancers for GBA	Expected number of Cancer Colorectal	Ratio
0-9	0	0.00	0.00
10-19	0	0.02	0.00
20-29	0	0.02	0.00
30-39	**	0.28	**
40-49	**	1.42	**
50-59	6	3.56	1.68
60-69	6	7.24	0.83
70-79	9	9.60	0.94
80+	7	5.51	1.27
Total	31	27.64	1.12
SMR =	1.12		
95% LCL =	0.73		
95% UCL =	1.52		
p-value	0.52		

** Data suppressed due to small number of observed events

Oral Cancers (ICD-9: 140-149)

Between 1989 and 2001, there were 19 cases of malignant cancer of the oral cavity (ICD-9: 140-149) diagnosed among residents living in the Greater Belledune Area. Figure 4.10 shows that cases in the GBA were diagnosed between 40 and 80+ years of age. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 60.63 and 63.67 years for residents of GBA and the comparison population respectively, a difference of 3.04 years. This difference was not statistically significant (p = 0.38). Overall, the incidence of oral cancer in the GBA was higher than expected (n=6). The SIR showed that there was an excess of cancer of the oral cavity (ICD-9: 140-149) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 3.05, 95% CI: 1.68-4.42).

Figure 4.10: Percent distribution of incidence of oral cancers (ICD-9: 140-149) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 60.63 years*
- *New Brunswick Standard Population: 63.67 years*
- *Difference: -3.04 years (t-test: p = 0.38)*

Table 4.14: Standardized incidence ratio (SIR) for oral cancers (ICD-9: 140-149) for the Greater Belledune Area (GBA), 1989-2001.
**

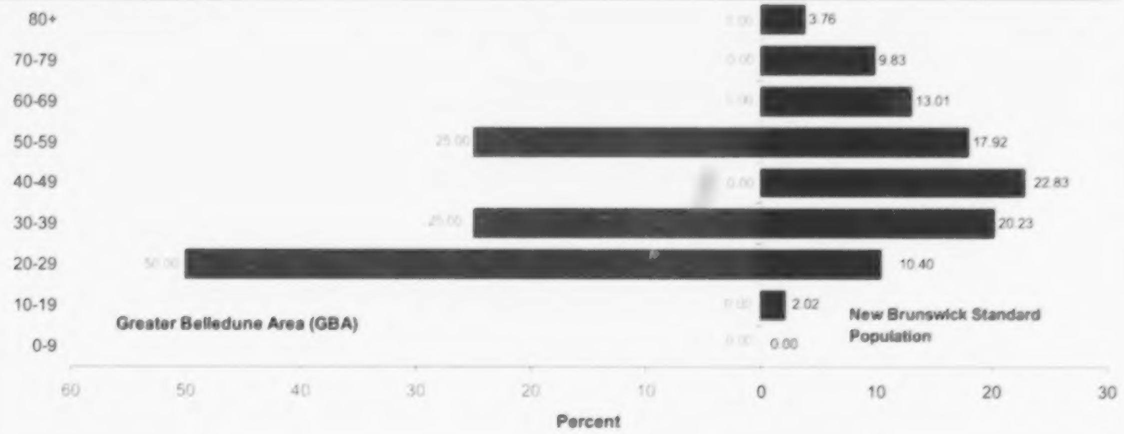
Age-Group (Years)	Observed Cancers for GBA	Expected number of oral cancers	Ratio
0-9	0	0.00	0.00
10-19	0	0.05	0.00
20-29	0	0.04	0.00
30-39	0	0.17	0.00
40-49	**	0.80	**
50-59	7	1.33	5.26
60-69	**	1.82	**
70-79	**	1.46	**
80+	**	0.55	**
Total	19	6.23	3.05
SIR =	3.05		
95% LCL =	1.68		
95% UCL =	4.42		
p-value	<0.01		

*** Data suppressed due to small number of observed events*

Thyroid Cancer (ICD-9: 193)

Between 1989 and 2001, there were less than 5 cases of malignant cancer of the thyroid (ICD-9: 193) diagnosed among residents living in the Greater Belledune Area. Figure 4.11 shows that cases in the GBA were diagnosed between 20 and 59 years of age. On average, residents of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 33.50 and 48.82 years for residents of GBA and the comparison population respectively, a difference of 15.32 years. This difference was not statistically significant (p = 0.07). Overall, the incidence of thyroid cancer in the GBA was higher than expected (n=3). The SIR showed that there was a non-statistical significant excess of cancer of the thyroid (ICD-9: 193) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 1.34, 95% CI: 0.03-2.65). This estimate was based on very few observations; therefore, results must be interpreted with caution.

Figure 4.11: Percent distribution of incidence of thyroid cancer (ICD-9: 193) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 33.50 years*
- *New Brunswick Standard Population: 48.82 years*
- *Difference: -15.32 years (t-test: p = 0.07)*

Table 4.15: Standardized incidence ratio (SIR) for thyroid cancer (ICD-9: 193) for the Greater Belledune Area (GBA), 1989-2001.

Age-Group (Years)	Observed Cancers for GBA	Expected number of thyroid cancers	Ratio
0-9	0	0.00	0.00
10-19	0	0.06	0.00
20-29	**	0.27	**
30-39	**	0.57	**
40-49	0	0.76	0.00
50-59	**	0.57	**
60-69	0	0.39	0.00
70-79	0	0.28	0.00
80+	0	0.09	0.00
Total	**	2.99	**
SIR =	1.34		
95% LCL =	0.03		
95% UCL =	2.65		
p-value	**		

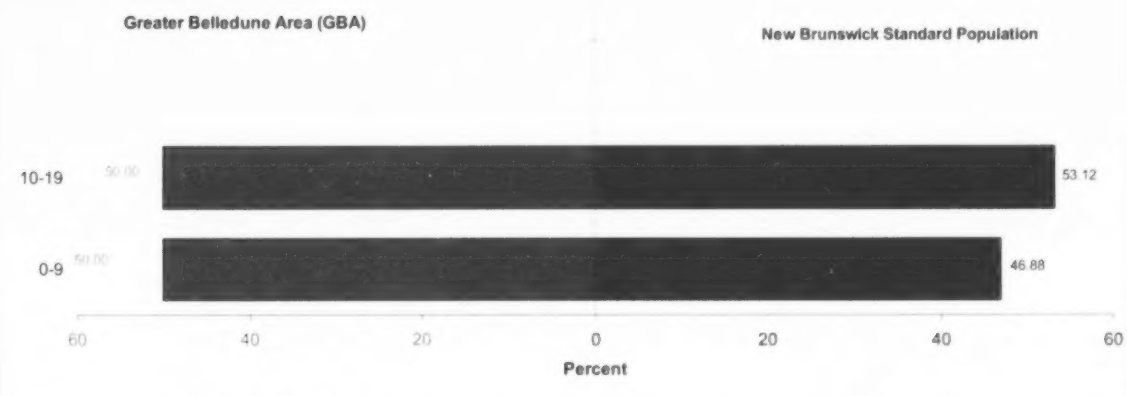
*** Data suppressed due to small number of observed events*

CANCER IN CHILDREN AND TEENAGERS (AGE:0-19)

All Cancers (ICD-9: 140-208) and Leukemia (ICD-9: 204-208)

Overall, there were very few cancers diagnosed among residents of the Greater Belledune Area who were less than 20 years of age. Between 1989 and 2001, there were 6 cases of malignant cancer all types (ICD-9: 140-208). On average, children and young adults of GBA were diagnosed earlier than the comparison population. The average age of diagnosis was 9.00 and 9.97 years for residents of GBA and the comparison population respectively, a difference of 0.97 years. This difference was not statistically significant (p = 0.72). Overall, the incidence of all cancer in the GBA was higher than expected (n=3). The SIR showed that there was a non-significant excess of all cancers (ICD-9: 140-208) diagnosis in the GBA when using rates generated from the New Brunswick standard population (SIR = 2.25, 95% CI: 0.45-4.05). Similarly, SIR was also calculated for leukemia (ICD-9:204-208) for the same age group. The SIR for leukemia showed a non-significant excess of cases of leukemia (SIR = 4.56, 95% CI: 0.00-9.72. Again, these estimates were based on very few observations; therefore, results must be interpreted with caution.

Figure 4.12: Percent distribution of all cancers (ICD-9: 140-208) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

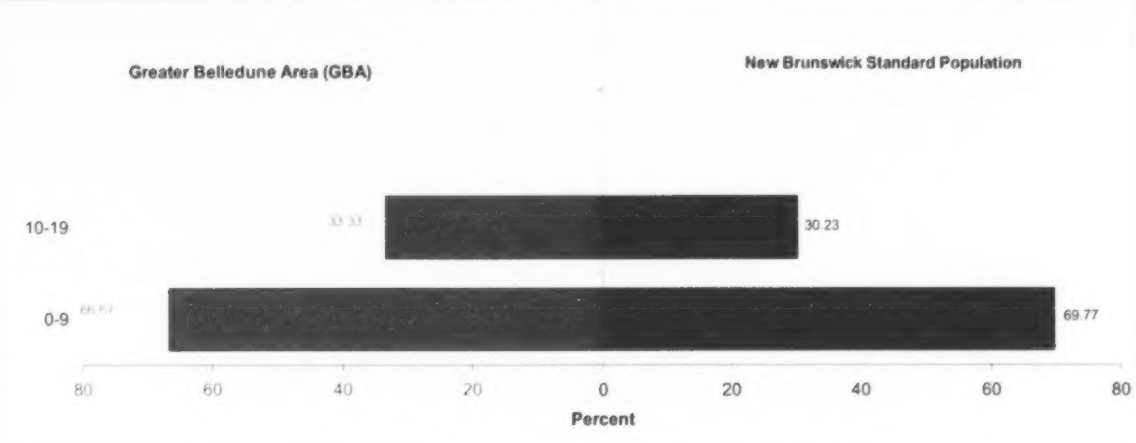
- *Greater Belledune Area: 9.00 years*
- *New Brunswick Standard Population: 9.97 years*
- *Difference: -0.97 years (t-test: p = 0.72)*

Table 4.16: Standardized incidence ratio (SIR) for all cancers (ICD-9: 140-208) for the Greater Belledune Area (GBA), 1989-2001.

Age-Group (Years)	Observed Cancers for GBA	Expected number of all cancers	Ratio
0-9	**	1.13	**
10-19	**	1.54	**
Total	6	2.67	2.25
SIR =	2.25		
95% LCL =	0.45		
95% UCL =	4.05		
p-value	**		

*** Suppressed due to small numbers.*

Figure 4.13: Percent distribution of incidence of leukemia (ICD-9: 204-208) by 10-year age groups for the Greater Belledune Area and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Greater Belledune Area: 7.67 years*
- *New Brunswick Standard Population: 6.78 years*
- *Difference: 0.89 years (t-test: p = 0.80)*

Table 4.17: Standardized incidence ratio (SIR) for leukemia (ICD-9: 204-208) for the Greater Belledune Area (GBA), 1989-2001.

Age-Group (Years)	Observed Cancers for GBA	Expected number of cases of leukemia	Ratio
0-9	**	0.43	**
10-19	**	0.22	**
Total	**	0.65	**
SIR =	4.56		
95% LCL =	0.00		
95% UCL =	9.72		
p-value	**		

*** Suppressed due to small numbers.*

CANCER ANALYSES BY SEX

GBA vs. New Brunswick Standard

For the Greater Belledune Area, statistically significant excesses in cancers were observed for all cancers combined (SIR= 1.36, 95% CI: 1.23-1.50), respiratory cancer (SIR=1.70, 95% CI: 1.35-2.05), prostate cancer (SIR= 1.44, 95%CI: 1.08-1.79), stomach cancer (SIR=3.72, 95%CI: 2.23-5.22), and oral cancer (SIR=3.05, 95% CI: 1.68-4.42). When stratified by sex, males' cancer risk were generally higher than females. For all cancers combined was statistically significantly higher than that of females (Males; SIR=1.53, 95%: CI 1.34-1.72, Females: SIR=1.13, 95% CI: 0.95-1.31). Similarly, for respiratory cancers (ICD9: 160-165), males cancer risk was approximately 83% higher than expected (SIR=1.83, 95% CI:1.39-2.27) while female cancer risk 33% higher (SIR=1.33; 95% CI: 0.79-1.88). Although the point estimate for female respiratory cancer risk was higher than expected, the excess risk was not statistically significant.[14]

For stomach and oral cancers, males were also generally higher than females, however, these were based on very few observations. Therefore, caution must be exercised in interpreting these results due to errors associated with random variation of small sample sizes.

Possible differences could be attributed to occupational exposure. However, one must also consider the contribution of cigarette smoke, diet, and physical activity level and other modifiable risk factors.

4.2.3 Comparisons between HR 5&6 and the NB Standard

All Cancers (ICD-9: 140-208)

Between 1989 and 2001, there were 6,540 cases of malignant cancers (ICD-9:140-208, excluding non-melanotic skin) diagnosed among residents of Health Regions 5&6 for both males and females combined. Figure 4.14 shows that most of these cases are distributed among those who were 50 years of age or older. The most frequently diagnosed cancer (Table 4.18) was respiratory and intra-thoracic organs (ICD-9: 160-165, 1,207 cases or 18%). On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 65.14 and 66.09 years for residents of HR 5&6 and the comparison population respectively, a statistically significant difference of 0.95 years (p = <0.01). The SIR showed that there wasno excess in cancer diagnosed in the HR 5&6 for all cancers (ICD-9: 140-208) when using rates generated from the New Brunswick standard population (SIR = 0.99, 95% CI: 0.96-1.01).

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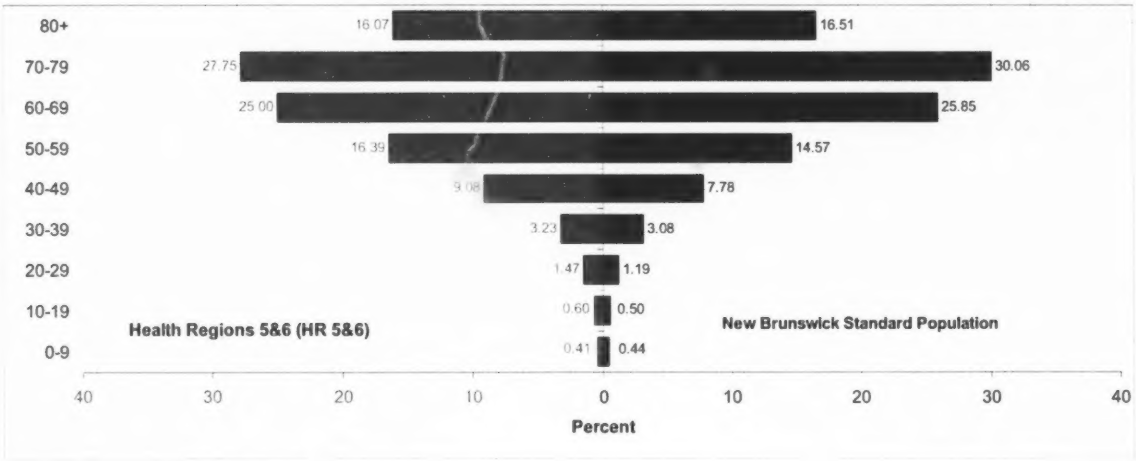
[14] Site-specific respiratory cancer was also examined. Most of the cancer in the "Respiratory Cancer" category were cancer of the trachea, bronchus, and lung (ICD9: 162), therefore, the risk estimate for those classified as ICD9: 162 were similar to that of the entire respiratory cancer category. Risk estimate for respiratory cancer other than ICD9:162 are not presented for GBA due to very few or no observations.

Figure 4.14: Percent distribution of cancer incidence (all cancers, ICD-9: 140-208) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 65.14 years*
- *New Brunswick Standard Population: 66.09 years*
- *Difference: -0.95 years (t-test: p = <0.01)*

Table 4.18: Percent distribution of invasive incidence cancer site among by geographic area, 1986-2001

Health Regions 5& 6 (%)	Cancer Site Description (ICD-9 code)	New Brunswick Standard Population (%)
156 (2.39)	Lip, oral cavity, and pharynx (140-149)	729 (2.05)
41 (0.63)	Oesophagus (150)	312 (0.88)
259 (3.96)	Stomach (151)	793 (2.23)
18 (0.28)	Small intestine, including duodenum (152)	96 (0.27)
459 (7.02)	Colon (153)	3,388 (9.52)
352 (5.38)	Rectum, rectosigmoid junction and anus (154)	1,413 (3.97)
39 (0.60)	Liver and intra-hepatic bile ducts (155)	185 (0.52)
31 (0.47)	Gallbladder and extra-hepatic bile ducts (156)	183 (0.51)
179 (2.74)	Pancreas (157)	857 (2.41)
20 (0.31)	Digestive system (other and unspecified, 158,159)	140 (0.39)
1,207 (18.46)	Respiratory (trachea, lung) and intra-thoracic organs (160-165)	6,315 (17.75)
216 (3.30)	Bone, connective tissue and skin (170-173, 176)	1,508 (4.24)
797 (12.19)	Breast (174, 175)	4,805 (13.51)
30 (0.46)	Female genital organ (other) (179, 181, 184)	163 (0.46)
95 (1.45)	Female genital organ (cervix) (180)	370 (1.04)
111 (1.70)	Female genital organ (Corpus uteri) (182)	807 (2.27)
97 (1.48)	Ovary and other uterine adnexa (183)	529 (1.49)
1,001 (15.31)	Prostate (185)	5,108 (14.36)
21 (0.32)	Testis (186)	147 (0.41)
10 (0.15)	Male genital organs (other) (187)	55 (0.15)
279 (4.27)	Bladder (188)	1,582 (4.45)
230 (3.52)	Kidney, other, and unspecified urinary organs (189)	1,130 (3.18)
11 (0.17)	Eye (190)	65 (0.18)
107 (1.64)	Brain and central nervous system (191,192)	557 (1.57)
90 (1.38)	Thyroid gland (193)	346 (0.97)
12 (0.18)	Other endocrine (194)	31 (0.09)
143 (2.19)	Ill-defined and primary sites unknown (195-199)	1,060 (2.98)
276 (4.22)	Lymphoma (other) (200, 202)	1,504 (4.23)
30 (0.46)	Hodgkin's disease (201)	202 (0.57)
61 (0.93)	Multiple myeloma (203)	421 (1.18)
162 (2.48)	Leukemia (204-208)	778 (2.19)
6,540	**Total**	**35,579**

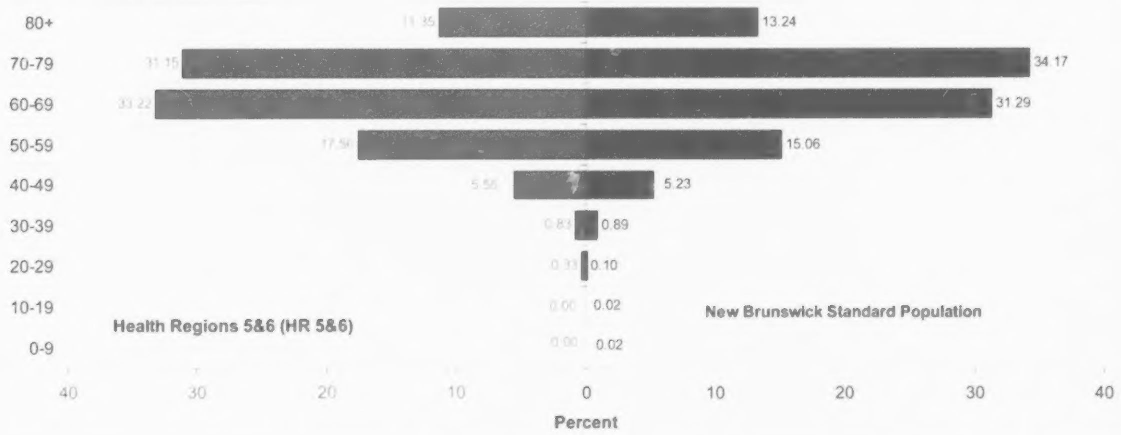
Table 4.19: Standardized incidence ratio (SIR) for all cancers (ICD-9: 140-208) for the Health Regions 5&6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of all cancers	Ratio
0-9	27	28.37	0.95
10-19	39	36.81	1.06
20-29	96	79.32	1.21
30-39	211	219.51	0.96
40-49	594	570.32	1.04
50-59	1072	1051.49	1.02
60-69	1635	1741.42	0.94
70-79	1815	1866.15	0.97
80+	1051	1023.01	1.03
Total	6540	6616.39	0.99
SIR=	0.99		
95% LCL=	0.96		
95% UCL=	1.01		
P-value	0.35		

Respiratory (Lung, Trachea, and Intra-thoracic) Cancer (ICD-9: 10-165)

Between 1989 and 2001, there were 1,207 cases of malignant cancers of the respiratory track (ICD-9: 160-165) diagnosed among residents of Health Regions 5&6 for both males and females combined. Figure 4.15 shows that most of these cases are distributed among those who were 40 years of age or older. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 66.86 and 67.77 years for residents of HR 5&6 and the comparison population respectively, a difference of 0.91 years (p = 0.01). Overall, the incidence of respiratory cancer in the HR 5&6 was slightly higher that expected (n=1170). The SIR showed that there was no statistically significant excess in cancer diagnosis in the HR 5&6 for all cancers of the respiratory system (ICD-9: 160-165) when using rates generated from the New Brunswick standard population (SIR = 1.03, 95% CI: 0.97-1.09).

Figure 4.15: Percent distribution of incidence of respiratory cancer (ICD-9: 160-165) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 66.86 years*
- *New Brunswick Standard Population: 67.77 years*
- *Difference: -0.91years (t-test: p = 0.01)*

Table 4.20: Standardized incidence ratio (SIR) for respiratory cancer (ICD-9: 160-165) for the Health Regions 5&6 1989-2001.

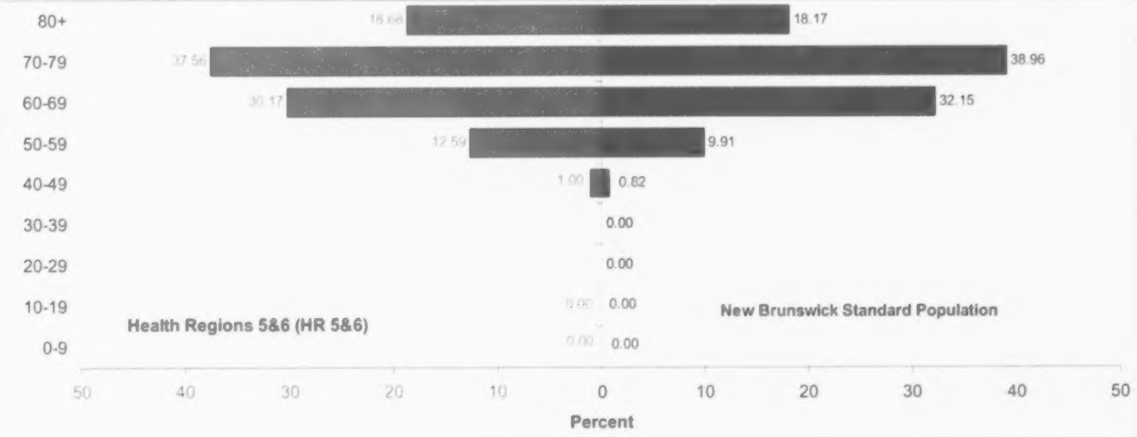
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of respiratory cancers	Ratio
0-9	0	0.18	0.00
10-19	0	0.21	0.00
20-29	**	1.12	**
30-39	**	11.22	**
40-49	67	67.99	0.99
50-59	212	192.90	1.10
60-69	401	374.11	1.07
70-79	376	376.51	1.00
80+	137	145.57	0.94
Total	1207	1169.80	1.03
SIR=	1.03		
95% LCL=	0.97		
95% UCL=	1.09		
P-value	0.28		

*** Suppressed due to small numbers.*

Prostate Cancer (ICD-9: 185)

Between 1989 and 2001, there were 1,001 cases of malignant cancer of the prostate (ICD-9: 185) diagnosed among men living in Health Regions 5&6. Figure 4.16 shows that most cases were 50 years of age or older. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 70.78 and 71.03 years for residents of HR 5&6 and the comparison population respectively, a difference of 0.24 years. However, the difference was not statistically significant (p = 0.44). Overall, the incidence of prostate cancer in the HR 5&6 was slightly higher that expected (n=977). The SIR showed that there was statistically significant excess in cancer diagnosis in the HR 5&6 for prostate cancer (ICD-9: 185) when using rates generated from the New Brunswick standard population (SIR = 1.02, 95% CI: 0.96-1.09).

Figure 4.16: Percent distribution of incidence of prostate cancer (ICD-9: 185) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 70.78 years*
- *New Brunswick Standard Population: 71.03 years*
- *Difference: -0.24 years (t-test: p = 0.44)*

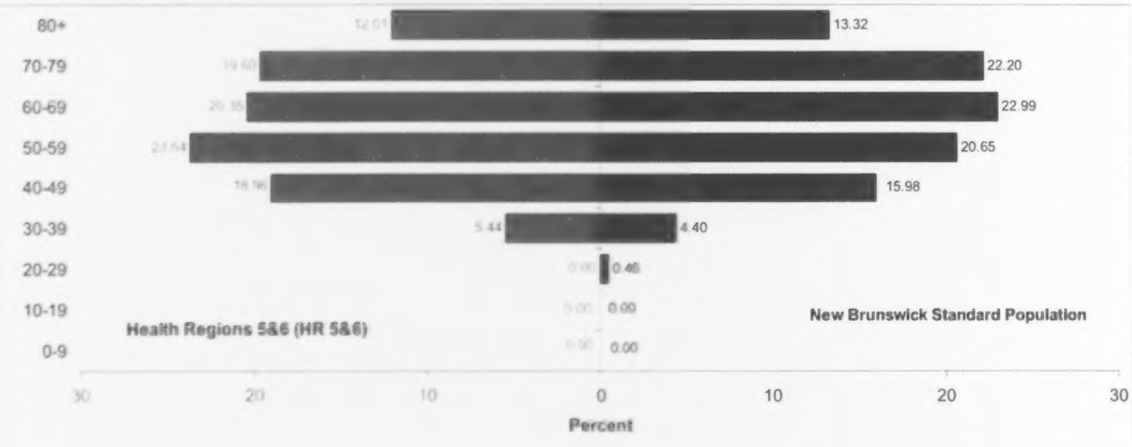
Table 4.21: Standardized incidence ratio (SIR) for prostate cancer (ICD-9: 185) for the Health Regions 5&6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of prostate cancers	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	0.00	0.00
30-39	0	0.00	0.00
40-49	10	8.72	1.15
50-59	126	104.53	1.21
60-69	302	318.44	0.95
70-79	376	367.02	1.02
80+	187	177.87	1.05
Total	1001	976.59	1.02
SIR=	1.02		
95% LCL=	0.96		
95% UCL=	1.09		
P-value	0.44		

Female Breast Cancer (ICD-9: 174)

Between 1989 and 2001, there were 791 cases of malignant cancers of the breast (ICD-9: 174) diagnosed among women living in Health Regions 5&6. Figure 4.17 shows that cases in the HR 5&6 were diagnosed between 20 and 80+ years of age. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 61.13 and 62.84 years for residents of HR 5&6 and the comparison population respectively, a difference of 1.36 years (p = 0.02). Overall, the incidence of breast cancer in the HR 5&6 was lower that expected (n=884). The SIR showed that there was a statistically significant reduction in cancer diagnosis in the HR 5&6 for cancer of the female breast (ICD-9: 174) when using rates generated from the New Brunswick standard population (SIR = 0.90, 95% CI: 0.83-0.96).

Figure 4.17: Percent distribution of incidence of female breast cancer (ICD-9: 174) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 61.13 years*
- *New Brunswick Standard Population: 62.84 years*
- *Difference: -1.71 years (t-test: p = 0.02)*

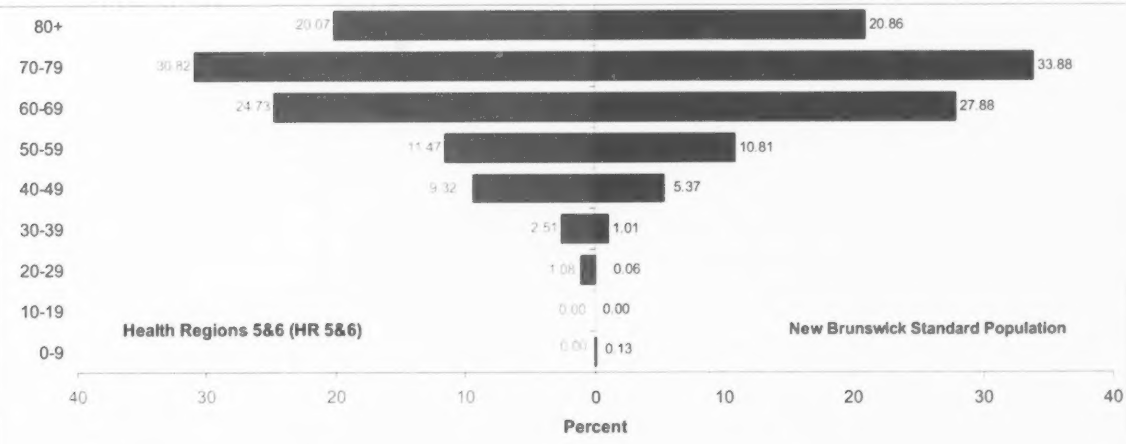
Table 4.22: Standardized incidence ratio (SIR) for female breast cancer (ICD-9: 174) for the Health Regions 5&6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of female breast cancers	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	4.10	0.00
30-39	43	42.08	1.02
40-49	150	155.99	0.96
50-59	187	196.29	0.95
60-69	161	203.28	0.79
70-79	155	177.01	0.88
80+	95	104.97	0.91
Total	791	883.73	0.90
SIR=	0.90		
95% LCL=	0.83		
95% UCL=	0.96		
P-value	0.002		

Bladder Cancer (ICD-9: 188)

Between 1989 and 2001, there were 279 cases of malignant cancers of the bladder (ICD-9: 188) diagnosed among residents living in Health Regions 5&6. Figure 4.18 shows that most cases in the HR 5&6 were diagnosed between 40 and 80+ years of age. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 67.96 and 69.89 years for residents of HR 5&6 and the comparison population respectively, a difference of 1.93 years (p = 0.02). Overall, the incidence of all bladder cancer in the HR 5&6 was lower than expected (n=291). The SIR showed that there was a non-statistically significant reduction in bladder cancer (ICD-9: 188) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 0.96, 95% CI: 0.87-1.07).

Figure 4.18: Percent distribution of incidence of bladder cancer (ICD-9: 188) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 67.96 years*
- *New Brunswick Standard Population: 69.89 years*
- *Difference: -1.93 years (t-test: p = 0.02)*

Table 4.23: Standardized incidence ratio (SIR) for bladder cancer (ICD-9: 188) for the Health Regions 5&6, 1989-2001.

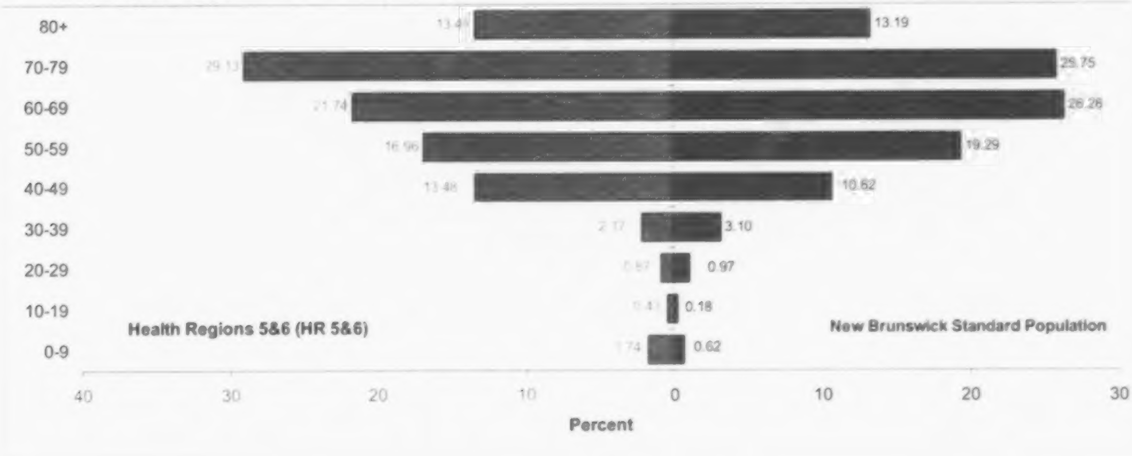
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of bladder cancers	Ratio
0-9	0	0.36	0.00
10-19	0	0.00	0.00
20-29	**	0.19	**
30-39	**	3.20	**
40-49	26	17.51	1.48
50-59	32	34.68	0.92
60-69	69	83.49	0.83
70-79	86	93.52	0.92
80+	56	57.46	0.97
Total	279	290.42	0.96
SIR=	0.96		
95% LCL=	0.85		
95% UCL=	1.07		
P-value	0.50		

*** Suppressed due to small numbers.*

Cancer of the Kidney (ICD-9: 189)

Between 1989 and 2001, there were 230 cases of malignant cancers of the kidney (ICD-9: 189) diagnosed among residents living in Health Regions 5&6. Figure 4.19 shows that most cases in the HR 5&6 were diagnosed between 40 and 80+ years of age. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 63.55 and 64.15 years for residents of HR 5&6 and the comparison population respectively, a difference of 0.65 years. This difference was not significant (p = 0.58). Overall, the incidence of all kidney cancer in the HR 5&6 was higher than expected (n=213). The SIR showed that there was a non- statistically significant excess in kidney cancer (ICD-9: 189) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 1.08, 95% CI: 0.94-1.22).

Figure 4.19: Percent distribution of incidence of cancer of the kidney (ICD-9: 189) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 63.55 years*
- *New Brunswick Standard Population: 64.15 years*
- *Difference: -0.60 years (t-test: p = 0.58)*

Table 4.24: Standardized incidence ratio (SIR) for cancer of the kidney (ICD-9: 189) for the Health Regions 5&6, 1989-2001.

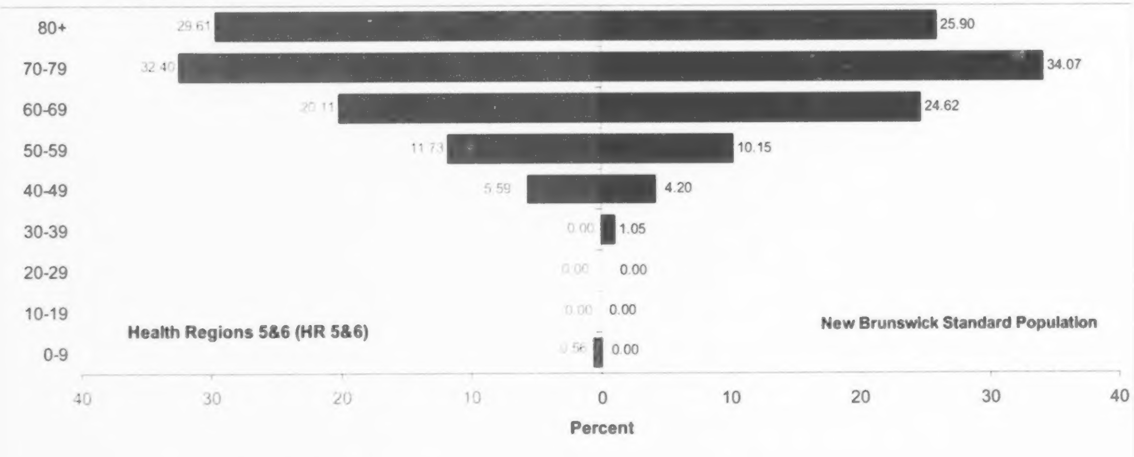
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of kidney cancer	Ratio
0-9	**	1.26	**
10-19	**	0.41	**
20-29	**	2.05	**
30-39	**	7.01	**
40-49	31	24.72	1.25
50-59	39	44.22	0.88
60-69	50	56.23	0.89
70-79	67	50.77	1.32
80+	31	25.95	1.19
Total	230	212.62	1.08
SIR=	1.08		
95% LCL=	1.22		
95% UCL=	0.94		
P-value	0.23		

*** Suppressed due to small numbers.*

Pancreatic Cancer (ICD-9: 157)

Between 1989 and 2001, there were 179 cases of malignant cancers of the pancreas (ICD-9: 157) diagnosed among residents living in Health Regions 5&6. Figure 4.20 shows that most cases in the HR 5&6 were diagnosed between 40 and 80+ years of age. On average, residents of HR 5&6 were diagnosed at similar age as the comparison population. The average age of diagnosis was 71.13 and 71.16 years for residents of HR 5&6 and the comparison population respectively. Overall, the incidence of all pancreatic cancer in the HR 5&6 was higher than expected (n=157). The SIR showed that there was a non-statistically significant reduction in pancreatic cancer (ICD-9: 157) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 1.14, 95% CI: 0.98-1.31).

Figure 4.20: Percent distribution of incidence of pancreatic cancer (ICD-9: 157) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 71.13 years*
- *New Brunswick Standard Population: 71.16 years*
- *Difference: -0.03 years (t-test: p = 0.96)*

Table 4.25: Standardized incidence ratio (SIR) for pancreatic cancer (ICD-9: 157) for the Health Regions 5&6, 1989-2001.

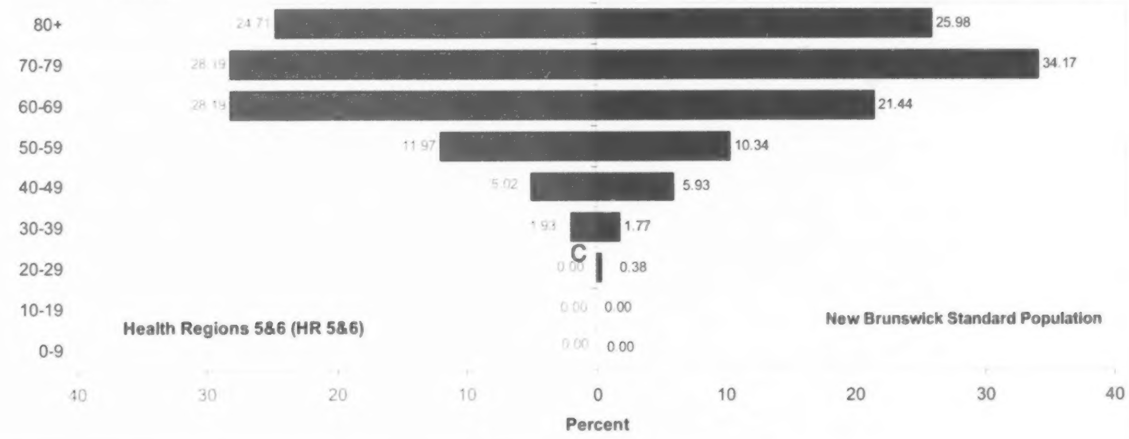
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of pancreatic cancers	Ratio
0-9	**	0.00	**
10-19	**	0.00	**
20-29	**	0.00	**
30-39	**	1.80	**
40-49	**	7.42	**
50-59	21	17.65	1.19
60-69	36	39.95	0.90
70-79	58	50.95	1.14
80+	53	38.66	1.37
Total	179	156.42	1.14
SIR=	1.14		
95% LCL=	1.31		
95% UCL=	0.98		
P-value	0.07		

*** Suppressed due to small numbers.*

Stomach Cancer (ICD-9: 151)

Between 1989 and 2001, there were 259 cases of malignant cancer of the stomach (ICD-9: 151) diagnosed among residents living in Health Regions 5&6. Figure 4.21 shows that cases in the HR 5&6 were diagnosed between 30 and 80+ years of age. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 68.86 and 70.56 years for residents of HR 5&6 and the comparison population respectively, a difference of 0.69 years. This difference was not statistically significant (p = 0.46). Overall, the incidence of all stomach cancer in the HR 5&6 was higher than expected (n=145). The SIR showed that there was an excess of stomach cancer (ICD-9: 151) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 1.79, 95% CI: 1.57-2.00).

Figure 4.21: Percent distribution of incidence of stomach cancer (ICD-9: 151) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 69.86 years*
- *New Brunswick Standard Population: 70.56 years*
- *Difference: -0.69 years (t-test: p = 0.46)*

Table 4.26: Standardized incidence ratio (SIR) for stomach cancer (ICD-9: 151) for the Health Regions 5&6, 1989-2001.

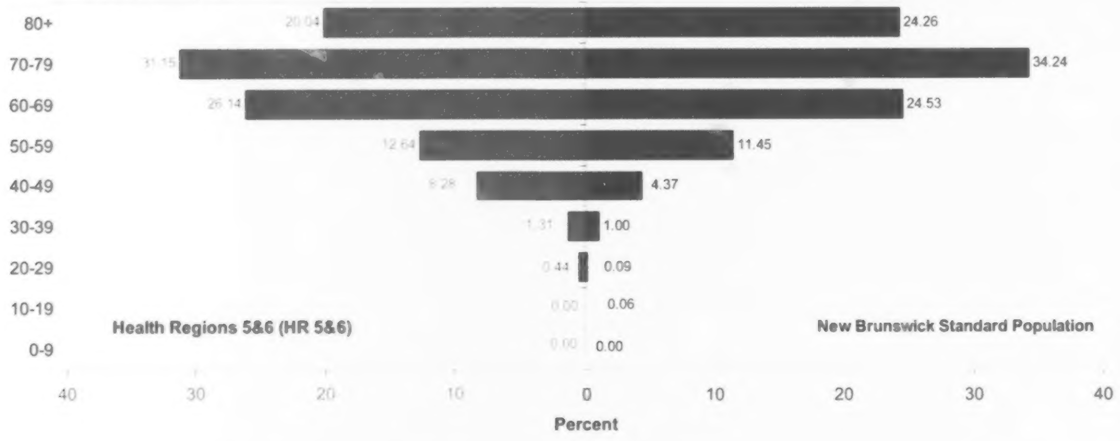
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of stomach cancers	Ratio
0-9	0	0.00	0.00
10-19	0	0.00	0.00
20-29	0	0.56	0.00
30-39	**	2.80	**
40-49	**	9.68	**
50-59	31	16.63	1.86
60-69	73	32.19	2.27
70-79	73	47.28	1.54
80+	64	35.87	1.78
Total	259	145.02	1.79
SIR=	1.79		
95% LCL=	2.00		
95% UCL=	1.57		
P-value	<.0001		

*** Suppressed due to small numbers.*

Colorectal Cancer (ICD-9: 153-154)

Between 1989 and 2001, there were 459 cases of malignant cancer of the colorectal (ICD-9: 153-154) diagnosed among residents living in Health Regions 5&6. Figure 4.22 shows that most cases in the HR 5&6 were diagnosed between 40 and 80+ years of age. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 68.23 and 70.77 years for residents of HR 5&6 and the comparison population respectively, a difference of 2.024 years. This difference was statistically significant (p = <0.01). Overall, the incidence of colorectal cancer in the HR 5&6 was lower than expected (n=620). The SIR showed that there was a statistically significant reduction in colorectal cancer (ICD-9: 153-154) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 0.74, 95% CI: 0.67-0.81).

Figure 4.22: Percent distribution of incidence of colorectal cancer (ICD-9: 153-154) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 68.75 years*
- *New Brunswick Standard Population: 70.77 years*
- *Difference: -2.02 years (t-test: p = <0.01)*

Table 4.27: Standardized incidence ratio (SIR) for colorectal cancer (ICD-9: 153-154) for the Health Regions 5&6, 1989-2001.

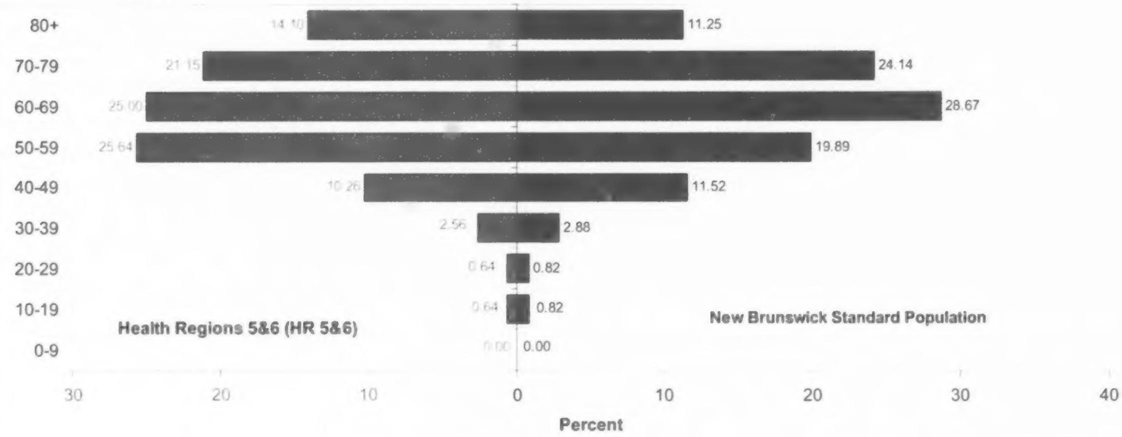
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of colorectal cancers	Ratio
0-9	0	0.00	0.00
10-19	0	0.41	0.00
20-29	**	0.56	**
30-39	**	6.81	**
40-49	38	30.49	1.25
50-59	58	78.70	0.74
60-69	120	157.33	0.76
70-79	143	202.39	0.71
80+	92	143.13	0.64
Total	459	619.83	0.74
SIR=	0.74		
95% LCL=	0.81		
95% UCL=	0.67		
P-value	<.0001		

*** Suppressed due to small numbers.*

Oral Cancers (ICD-9: 140-149)

Between 1989 and 2001, there were 156 cases of malignant cancer of the oral cavity (ICD-9: 140-149) diagnosed among residents living in Health Regions 5&6. Figure 4.23 shows that most cases in the HR 5&6 were diagnosed between 40 and 80+ years of age. On average, age of diagnosis for residents of HR 5&6 were similar to the comparison population. The average age of diagnosis was 63.42 and 63.67 years for residents of HR 5&6 and the comparison population respectively. Overall, the incidence of oral cancer in the HR 5&6 was higher than expected (n=138). The SIR showed that there was a non-statistically significant excess of cancer of the oral cavity (ICD-9: 140-149) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 1.13, 95% CI: 0.95-1.31).

Figure 4.23: Percent distribution of incidence of oral cancers (ICD-9: 140-149) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 63.42 years*
- *New Brunswick Standard Population: 63.47 years*
- *Difference: -0.05 years (t-test: p =0.97)*

Table 4.28: Standardized incidence ratio (SIR) for oral cancers (ICD-9: 140-149) for the Health Regions 5 & 6, 1989-2001.

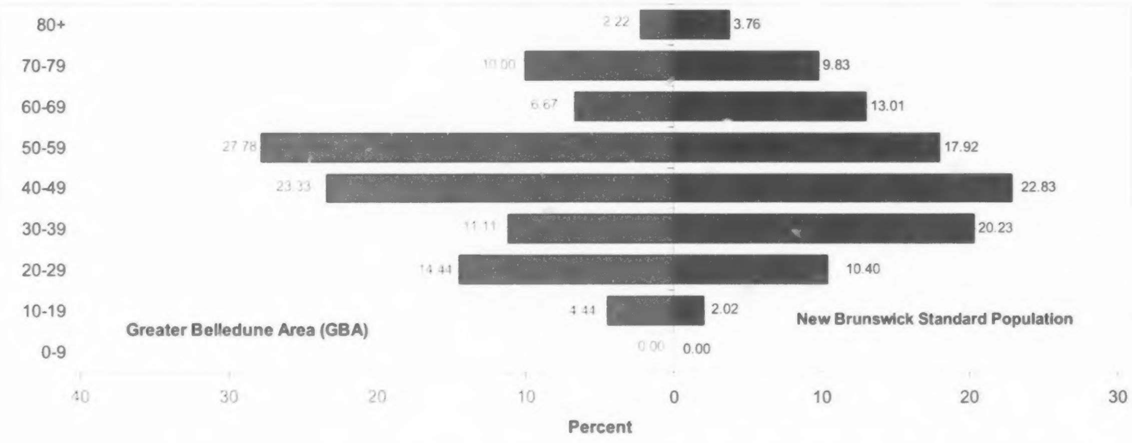
Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of oral cancers	Ratio
0-9	0	0.00	0.00
10-19	**	1.23	**
20-29	**	1.12	**
30-39	**	4.21	**
40-49	16	17.31	0.92
50-59	40	29.41	1.36
60-69	39	39.57	0.99
70-79	33	30.71	1.07
80+	22	14.28	1.54
Total	156	137.83	1.13
SIR=	1.13		
95% UCL=	1.31		
95% LCL=	0.95		
P-value	0.12		

*** Suppressed due to small numbers.*

Thyroid Cancer (ICD-9: 193)

Between 1989 and 2001, there were less than 90 cases of malignant cancer of the thyroid (ICD-9: 193) diagnosed among residents living in Health Regions 5&6. On average, residents of HR 5&6 were diagnosed earlier than the comparison population. The average age of diagnosis was 47.08 and 48.82 years for residents of HR 5&6 and the comparison population respectively, a difference of 1.74 years. This difference was not statistically significant (p = 0.38). Overall, the incidence of thyroid cancer in the HR 5&6 was higher than expected (n=68). The SIR showed that there was a statistically significant excess of cancer of the thyroid (ICD-9: 193) diagnosis in the HR 5&6 when using rates generated from the New Brunswick standard population (SIR = 1.33, 95% CI: 1.05-1.60).

Figure 4.24: Percent distribution of incidence of thyroid cancer (ICD-9: 193) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 47.08 years*
- *New Brunswick Standard Population: 48.82 years*
- *Difference: -1.74 years (t-test: p =0.38)*

Table 4.29: Standardized incidence ratio (SIR) for thyroid cancer (ICD-9: 193) for the Health Regions 5 & 6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of thyroid cancers	Ratio
0-9	0	0.00	0.00
10-19	**	1.44	**
20-29	13	6.72	1.93
30-39	10	14.02	0.71
40-49	21	16.28	1.29
50-59	25	12.58	1.99
60-69	**	8.52	**
70-79	9	5.93	1.52
80+	**	2.26	**
Total	90	67.75	1.33
SIR=	1.33		
95% LCL=	1.60		
95% UCL=	1.05		
P-value	0.007		

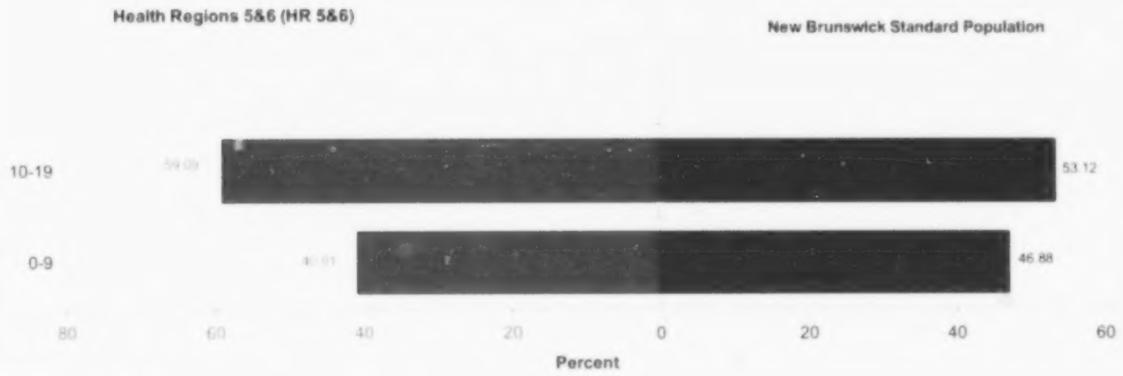
*** Suppressed due to small numbers.*

CANCER AMONG CHILDREN AND TEENAGERS

All Cancers (ICD-9: 140-208); Leukemia (ICD-9: 204-208); Hodgkin's Disease (ICD-9: 201)

Between 1989 and 2001, there were 66 cases of malignant cancer all types (ICD-9: 140-208) among children and young adults under the age of 20 years. The average age of diagnosis for this age group was virtually the same. The average age of diagnosis was 9.98 and 9.97 years for residents of HR 5&6 and the comparison population respectively. The SIR showed no difference in cancer risk for all cancers (ICD-9 140-208) among this age group (SIR = 1.01, 95% CI: 0.77-1.26). Similarly, SIR was also calculated for leukemia (ICD-9:204-208) for the same age group. The SIR was calculated for leukemia and Hodgkin's disease. The SIRs showed a statistically non-significant difference of the observed and expected cases of leukemia (SIR = 4.56, 95% CI: 0.00-9.72) and Hodgkin's disease (SIR = 0.75, 95% CI: 0.02-1.49).

Figure 4.25: Percent distribution of all cancers (ICD-9: 140-208) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



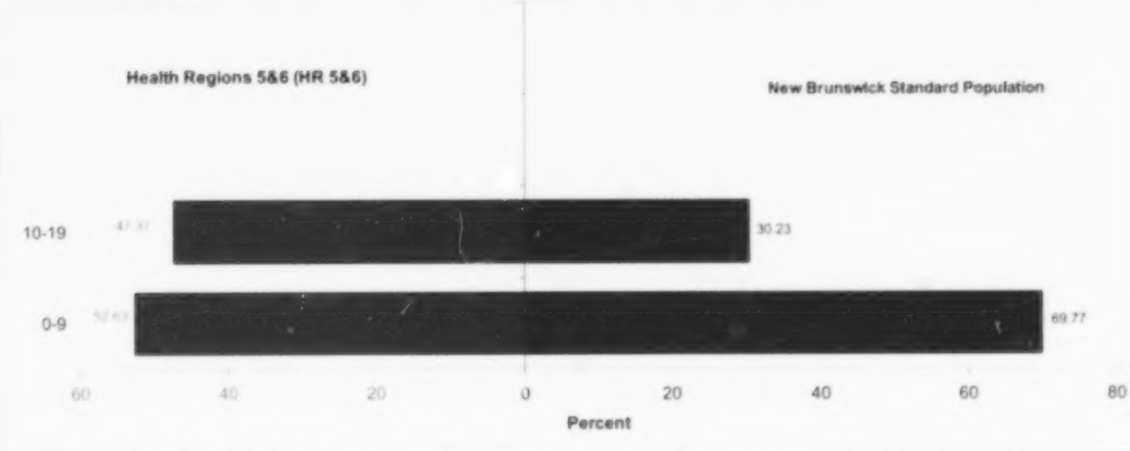
Mean age at diagnosis

- *Health Regions 5&6: 9.98 years*
- *New Brunswick Standard Population: 9.97 years*
- *Difference: 0.01 years (t-test: p= 0.99)*

Table 4.30: Standardized incidence ratio (SIR) for all cancers (ICD-9: 140-208) for the Health Regions 5&6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of cases	Ratio
0-9	27	28.37	0.95
10-19	39	36.81	1.06
Total	66	65.17	1.01
SIR=	1.01		
95% LCL=	1.26		
95% UCL=	0.77		
P-value	0.92		

Figure 4.26: Percent distribution of incidence of leukemia (ICD-9: 204-208) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



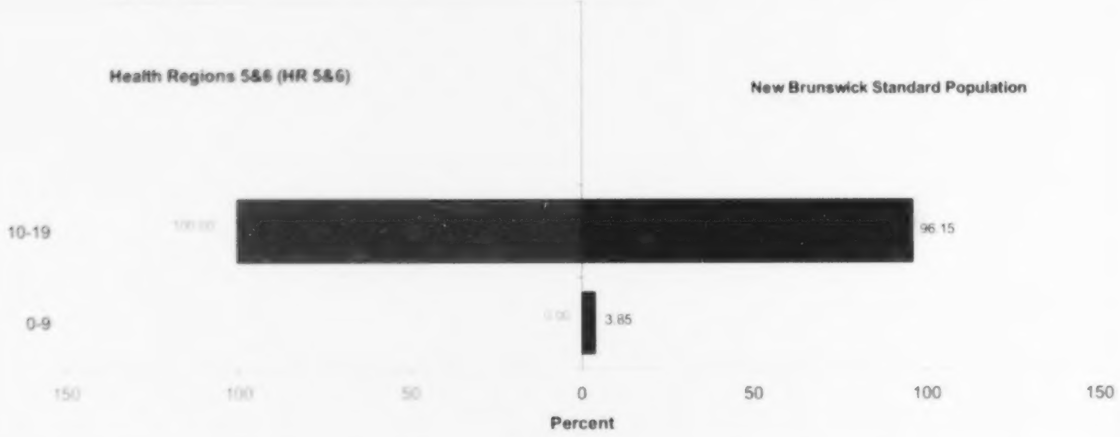
Mean age at diagnosis

- *Health Regions 5&6: 9.21 years*
- *New Brunswick Standard Population: 6.78 years*
- *Difference: 2.43 years (t-test: p = 0.11)*

Table 4.31: Standardized incidence ratio (SIR) for leukemia (ICD-9: 204-208) for the Health Regions 5&6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of cases	Ratio
0-9	10	10.77	0.93
10-19	9	5.35	1.68
Total	19	16.12	1.18
SIR=	1.18		
95% LCL=	1.71		
95% UCL=	0.65		
P-value	0.47		

Figure 4.27: Percent distribution of incidence of Hodgkin's disease (ICD-9: 201) by 10-year age groups for the Health Regions 5&6 and New Brunswick Standard Population, 1989-2001.



Mean age at diagnosis

- *Health Regions 5&6: 15.75 years*
- *New Brunswick Standard Population: 15.73 years*
- *Difference: 0.02 years (t-test: p= 0.99)*

Table 4.32: Standardized incidence ratio (SIR) for Hodgkin's disease (ICD-9: 201) for the Health Regions 5&6, 1989-2001.

Age-Group (Years)	Observed Cancers for HR 5&6	Expected number of Hodgkin's diseases	Ratio
0-9	**	0.18	**
10-19	**	5.14	**
Total	**	5.32	**
SIR=	0.75		
95% UCL=	1.49		
95% LCL=	0.02		
P-value	**		

*** Suppressed due to small numbers.*

CANCER ANALYSES BY SEX

HR 5&6 vs. New Brunswick Standard

For Health Regions 5&6, statistically significant excess in cancers were observed for stomach (SIR=1.79, 95% CI: 1.57-2.00) and thyroid cancer (SIR=1.33, 95% CI 1.05-1.60). Conversely, smaller than expected number of cases were observed for cancers of the colorectal (SIR = 0.74, 95% CI: 0.67-0.81) and (female) breast (SIR=0.90, 95% CI: 0.83-0.96). When stratified by sex, female thyroid cancers (SIR= 1.42, 95% CI: 1.10-1.75) were higher than males thyroid cancer (SIR= 1.06, 95% CI: 0.57-1.55).

There are a number of known risk factors for thyroid cancer including exposure to ionizing radiation,[15] and dietary iodine.[16] Some studies also suggest that high consumption of seafood also contributed to higher incidence of thyroid cancer.[17] Differences in males and females thyroid cancer risk may be attributed to hormonal factors.[18]

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[15] Committee on the Biological Effects of Ionizing Radiation, *Health Effects of Exposure to Low Levels of Ionizing Radiation*, BEIR V. Washington: National Academy Press, 1996: 1000-21.

[16] Williams ED, Doniach I, Bjarnason O et al. *Thyroid cancer in an iodine-rich area: a histopathological study*. Cancer 1977; 39:215-22.

[17] Glattre E. Hardorsen E, Breg JP et al. Norwegian case-control study testing the hypothesis that seafood increases the risk of thyroid cancer, Cancer Causes & Control, 1993, 4: 11-16

[18] MacTierman AM, Weiss NS, Darling JR Incidence of thyroid cancer in women in relation to reproductive and hormonal factors, American Journal of Epidemiology, 1984, 120: 423-35.

SUMMARY

A summary of all the SIRs calculated by cancer site for both comparisons is presented below in Table 4.33.

Table 4.33: Standardized incidence ratio by cancer site for both comparisons.

Cancer Site (ICD-9 codes)	Greater Belledune Area				Health Regions 5&6			
	SMR	95% LCL	95% UCL	P-value	SMR	95% LCL	95% UCL	P-value
All Cancers (140-208)	1.36	1.23	1.50	<0.01	0.99	0.96	1.01	0.35
Respiratory Cancer (ICD9-: 160-165)	1.70	1.35	2.05	<0.01	1.03	0.97	1.09	0.28
Prostate Cancer (185)	1.44	1.08	1.79	<0.01	1.02	0.96	1.09	0.44
Breast Cancer (174)	0.83	0.55	1.11	0.28	0.90	0.83	0.96	<0.01
Bladder Cancer (188)	0.92	0.40	1.44	0.77	0.96	0.85	1.07	0.50
Kidney Cancer (189)	1.57	0.77	2.36	0.08	1.08	0.94	1.22	0.23
Pancreatic Cancer (157)	0.86	0.17	1.55	0.72	1.14	0.98	1.31	0.07
Stomach Cancer (151)	3.72	2.23	5.22	<0.01	1.79	1.57	2.00	<0.01
Colorectal Cancer (153-154)	1.12	0.73	1.52	0.52	0.74	0.67	0.81	<0.01
Oral Cancers (140-149)	3.05	1.68	4.42	<0.01	1.13	0.95	1.31	0.12
Thyroid Cancer (193)	1.34	0.03	2.65	**	1.33	1.05	1.60	<0.01
Cancer Among Children and Teenagers (age: 0-19)								
All Cancers (140-208)	2.25	0.45	4.05	**	1.01	0.77	1.26	0.31
Hodgkin's disease (201)	-	-	-	-	0.75	0.02	1.49	0.57
Leukemia (204-208)	4.60	0.00	9.82	**	1.18	0.65	1.71	0.48

* LCL= Lower/Upper Confidence Limits, ** suppression of data due to small numbers, No observations for, Hodgkin's disease in the Greater Belledune Area.

5.0 Hospital Separation

Hospital separations reflect the most responsible diagnosis each time a person is admitted and discharged from a hospital. These data are captured at the provincial level and then collated and analysed in a national information system (Hospital Medical Records Institute and Canadian Institute for Health Information). Each separation (i.e. discharge) is counted as an independent event, so that separations by one individual in two circumstances will be counted as two events. In order to aggregate events to individuals, a personal identification number or a statistical algorithm must be used to merge events to individuals. The present study did not aggregate separations to individuals, as personal identifiers were not available for the data received by the study team.

Community consultations revealed that there was considerable concern about the high number of cancer hospitalizations from GBA residents. The analysis of these data are thus in response to community concerns. Hospital discharge information is a good reflection of diseases or services such as surgical interventions (i.e. gall bladder removal, hysterectomy) which require single hospitalizations. When considering chronic conditions such as cancer or respiratory diseases such as asthma, which may require multiple admissions for diagnosis and treatment, hospital separations do not reflect as precisely the population rates of disease, but rather the use of hospital services.

The analysis covered the period 1989 to 2001 inclusive. Analyses were conducted comparing rates of hospital separations according to the following disease groups:

- Disease of the respiratory system (ICD-9: 460-519)
- Disease of the circulatory system (ICD-9: 390-459)
- Disease of the digestive system (ICD-9: 520-579)
- Disease of the genitourinary system (ICD-9: 580-629)
- Endocrine, nutritional & metabolic disorder (ICD-9: 240-279)
- Skin & subcutaneous tissue (ICD-9: 680-709)

The overall hospital separation rate was higher in both GBA and in HR 5&6 when compared to the rest of NB. Hospital separations were higher in all categories in all comparisons as illustrated in Tables 5.1 and 5.2 below.

Table 5.1: Standardized morbidity ratio (SMR) for selected hospital separations by most responsible diagnosis for Greater Belledune Area, 1989/90 to 2001/02

Most Responsible Diagnosis (ICD-9)	Observed	Expected	SMR	95% LCL	95% UCL	P-value
Disease of the respiratory system (ICD-9: 460-519)	1521	1186.15	1.28	1.22	1.35	<0.01
Disease of the circulatory system (ICD-9: 460-519)	1982	1492.31	1.33	1.27	1.39	<0.01
Disease of the digestive system (ICD-9: 520-579)	2085	1832.19	1.14	1.09	1.19	<0.01
Disease of the genitourinary system (ICD-9: 580-629	1846	1597.00	1.16	1.10	1.21	<0.01
Endocrine, nutritional & metabolic disorder (ICD-9: 240-279)	308	229.16	1.34	1.19	1.49	<0.01
Skin & subcutaneous tissue (ICD-9: 680-709)	278	219.09	1.27	1.12	1.42	<0.01
All causes	16753	14715.45	1.14	1.12	1.16	<0.01

Table 5.2: Standardized morbidity ratio (SMR) for selected hospital separation by most responsible diagnosis for Health Regions 5&6, 1989/90 to 2001/02

Disease Classification (ICD-9)	Observed	Expected	SMR	95% LCL	95% UCL	P-value
Disease of the respiratory system (ICD-9: 460-519)	38867	27832.95	1.40	1.38	1.41	<0.01
Disease of the circulatory system (ICD-9: 460-519)	37145	33484.66	1.11	1.10	1.12	<0.01
Disease of the digestive system (ICD-9: 520-579)	49948	42069.87	1.19	1.18	1.20	<0.01
Disease of the genitourinary system (ICD-9: 580-629	37033	36417.13	1.02	1.01	1.03	<0.01
Endocrine, nutritional & metabolic disorder (ICD-9: 240-279)	7138	5260.78	1.36	1.33	1.39	<0.01
Skin & subcutaneous tissue (ICD-9: 680-709)	6081	5075.38	1.20	1.17	1.23	<0.01
All causes	351107	339068.37	1.04	1.03	1.04	<0.01

6.0 Limitations and challenges

The limitations and challenges identified in conducting the CHSA focus to a certain extent on the design of the component and the availability of data.

6.1 Limitations with ecologic designs

The approach used for the CHSA is what is referred to as an *ecologic study*. Ecologic studies are those in which the unit of observation is a group, not separate individuals. . Ecologic studies may be used to generate hypotheses of an association between exposure and disease, but these studies cannot by themselves establish causation. This is because we do not know whether those individuals who died or suffered an illness in a particular geographic area under observation actually had a higher exposure than individuals who remained alive or did not experience the illness.[19] In addition, there may not be information about confounding factors (e.g., smoking) for individuals within an area population, and lack of this information limits the translation of population risks from ecologic studies to individual risks in members of the studied population. The conclusions made here are therefore for the GBA population as a whole, not for individuals therein. While the findings may not necessarily apply to individuals in an area, an ecologic study reveals findings about the population of an area, which may have implications for the individuals in that area.

6.2 Child development data

One of the major gaps in addressing community concerns and potential health impacts from the identified COPC was with respect to the absence of data on child development issues, either current or historic. The study team reviewed some potential sources (e.g., Early Childhood Initiative) but concluded that they were not collected in a sufficiently standardized or systematic manner to the extent that population level conclusions could be drawn.

In order to partially remedy this from a current perspective, the study team recommended that a pilot survey be conducted of blood lead levels in children likely to be most impacted from exposure to lead by living in closest proximity to the lead smelter. Given the strong relationship that exists between blood lead levels and health impacts, the study team felt that this type of information would assist the team in drawing at least some preliminary conclusions with respect to exposure levels and potential health impacts for current exposure. Unfortunately, this does not address child development issues potentially related to lead exposure in previous time periods, when the actual exposure levels were likely significantly higher.

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[19] http://hsrd.durham.med.va.gov/ERIC/ (Epidemiology Notebook)

6.3 Disease specific registries

The only disease specific registry that exists in NB is for cancer. The data for cancer registries in Canada is standardized and relatively complete. As a result, the study team was able to produce solid findings to address many of the residents' concerns with cancer incidence in the GBA. Unfortunately, there are no other disease specific registries, so the study team was unable to go into as much detail with respect to incidence rates for other disease groups. The study team attempted to offset this gap in part by examining mortality and hospital separations. It must be noted that limitations exist with using hospital separation data (e.g., availability of service). Therefore, results based on this data must be interpreted with caution.

6.4 Data on determinants of health

As mentioned previously, the health of a population is multi-faceted with many different determinants of health. These include such characteristics as lifestyle factors (e.g., smoking), diet, sex, occupation, biological make-up, physical activity levels, socio-economic status, environment, and medical services. The study team did not have access to data that provided additional information on these determinants for the populations studied. As a result, it is challenging to try to associate the health status of the study area to any specific health determinant. The only way to provide some indication of likely associations is to hypothesize based on the etiology of certain diseases, and what we know likely associations to be according to the scientific literature. Again, as indicated above, this will generate hypothesis of potential association, but will not address causality in any way.

7.0 Conclusions and discussion

7.1 How does the health status of residents compare with other regions?

The health status pattern for the GBA is different from that found in the surrounding health regions (HR 5&6) and for NB overall for the time period of 1989-2001. There is elevated incidence of oral, respiratory and prostate cancer (stomach cancer was found to be elevated in both GBA and HR 5&6). There is a higher mortality rate than expected, and there are more deaths due to circulatory disease, cancer and to "other causes" such as accidents and suicide than expected. Hospital separations were higher than expected for all disease groups; however, this was found to be the case for the HR 5&6 as well, so is not unique to the GBA.

As previously discussed, ecologic studies may be used to generate hypotheses of an association between exposure and disease, but these studies cannot by themselves establish causation. Further investigation will be required to assist in explaining what factors or characteristics of the residents of GBA are related to their current pattern of health status.

7.2 Overall discussion of findings

7.2.1 Reproductive outcomes

Reproductive outcomes are an extremely useful measure of the health status of a community. They synthesize many measures of pre-pregnancy health status (nutrition and chronic disease), pregnancy care, work status of the mother, access to health care, socioeconomic status, social support and environmental exposures.

The factors that contribute to low birth weight are complex. Adverse reproductive outcomes such as low birth weight (weight less than 2500 grams) reflect nutritional and smoking status of the mother, and they prognosticate developmental behavior of the child, including survival in the first year of life.[20] Most recently they also reflect multiple birth frequency, as this is associated with lower birth weight. Most importantly, they also present an outcome which makes sense to study recent exposures of the fetus derived from maternal exposures over a precise period of time, nine months, and from recent environmental exposures just prior to pregnancy. Pregnancy offers a short observation period in comparison to the long period required after exposure to observe the occurrence of cancer.

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[20] Ananth CV, Platt RW. Reexamining the effects of gestational age, fetal growth, and maternal smoking on neonatal mortality. BMC Pregnancy and Childbirth 2004, 4:22 doi:10.1186/1471-2393-4-22

Characteristics of a birth are gathered systematically for the population in the vital statistics data base. Among these are age of mother, vital status (live or stillbirth), birth weight, gestational age, and presence of a birth defect. Because of the high quality of the birth data, the short period of potential environmental influences on the fetus, reproductive outcomes may be used as a mirror of environmental, social and health care influences. In short, they are a good measure of population health status overall.

Smoking is one of the most pervasive toxicants in pregnancy. The effects of smoking are reflected in slowed fetal intrauterine growth and in prematurity.[21]

Birth defects may be associated with nutritional deficiencies (folic acid and spinal cord defects), drugs (vitamin A congeners and ear defects), alcohol (fetal alcohol syndrome) and potentially low level environmental toxicant effects.[22]

None of the measures of reproductive outcomes was different for GBA, HR 5&6 and NB.

7.2.2 Mortality

GBA males experienced statistically higher mortality than expected for cancer, circulatory system diseases and "other causes" such as accidents and suicide. GBA females experienced elevated mortality rates for cancer (albeit not statistically significant). This mortality pattern may be related to a combination of many risk factors.

Associated Factors – tobacco use

Because smoking alone can contribute significantly to cancer and circulatory disease[23], it would be extremely important to know the historical smoking rates in this population as well as current patterns before attributing elevated mortality to any specific risk factors or sets of risk factors. Socioeconomic status has generally been accepted as related to smoking rates[24].

Associated Factors – environmental exposures

It has been suggested that background arsenic exposure could be related to health outcomes in GBA such as the metabolic and circulatory disease mortality experience. The scientific literature indicates that in areas of high arsenic exposure from drinking water there is a higher prevalence and mortality of diabetes (a metabolic disease), hypertension and cardiovascular disease.[25]

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[21] 21 Statistics Canada (1999) and Federal Provincial Committee on Population Health.

[22] The Motherisk Program. The Hospital for Sick Children, Toronto, Ontario

[23] Ezzati M, Lopez AD. Regional, disease specific patterns of smoking-attributable mortality in 2000. Tob Control. 2004 Dec;13(4):388-95.

[24] Gilman SE, Abrams DB, Buka SL. Socioeconomic status over the life course and stages of cigarette use: initiation, regular use, and cessation. J Epidemiol Community Health. 2003 Oct;57(10):802-8.

We would not expect to see arsenic-related adverse outcomes in GBA because the estimated average levels of exposure are low as per calculations carried out in the HHRA (see Appendix A). As well, it should be noted that where effects have been seen in other populations, the exposure to arsenic is from extremely high levels of arsenic in drinking water, a condition that does not appear to exist in GBA as judged from results of distributed municipal and well water. Where arsenic effects are documented well, population effects result from long term exposure through drinking water containing highly available dissolved inorganic arsenic from natural sources. Soil arsenic is not as available and ingestion is variable and can be controlled.

The HHRA demonstrated that potential arsenic exposure for GBA residents are below the TRV of 0.002 mg/kg/day. This is well below the exposure levels of populations that have experienced a higher prevalence and mortality of diabetes, hypertension and cardiovascular disease. These reasons combined with the different mortality rates for circulatory diseases between men and women which would be expected to be similar if there were an arsenic exposure effect, do not support an association between arsenic exposure and circulatory disease, but do point to other differential risk factors between men and women in the GBA.

7.2.3 Cancer Incidence

7.2.3.1 Prostate Cancer

The causes of prostate cancer are not known, but there are some risk factors that have been shown in studies to increase the risk of prostate cancer: age, family history, race (Caucasians at lower risk than African Americans or Asians and American Indians), and diet (lower risk from fruits, vegetables and higher risk from animal fat and meats). Many studies are currently taking place examining the role of other risk factors and interventions.[26,27,28]

The age standardized incidence rate of prostate cancer in Canada has increased from 73.1 in 1975 to 121.2 in 2004 while mortality has remained about the same (about 27 per 100,000) with a minor rise preceding and then falling in the 1990s. The increased incidence rate has been attributed to earlier detection through the use of prostate specific antigen testing. In NB, the prostate cancer incidence rate is 140 per 100,000.[29]

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[25] Tchounwou PB, Patlolla AK, Centeno JA. Carcinogenic and Systemic Health Effects Associated with Arsenic Exposure-A Critical Review. Toxicologic Pathology 32003;31:575-588.

[26] Bostwick DG, Burke HB, Djakiew D, Euling S, Ho SM, Landolph J, Morrison H,Sonawane B, Shifflett T, Waters DJ, Timms B.Human prostate cancer risk factors. Cancer. 2004 Nov 15;101(10 Suppl):2371-490

[27] Carter BS, Carter HB, Isaacs JT.
Epidemiologic evidence regarding predisposing factors to prostate cancer. Prostate. 1990;16(3):187-97

[28] Mettlin C.Recent developments in the epidemiology of prostate cancer. Eur J Cancer. 1997 Mar;33(3):340-7.

Associated Factors – environmental exposures

An environmental cause for prostate cancer has not been postulated.

Associated Factors – occupational exposures

Occupational cadmium exposure has been considered in a number of studies as a potential risk factor. However, recent reviews of the literature do not support an association.[30] Arsenic exposure has not been associated with prostate cancer. Lead is not carcinogenic.

Within the limitations of the current study, it is not possible to state that there is any relationship between the industrial emissions in GBA, environmental exposure and the incidence of prostate cancer in the GBA.

7.2.3.2 Respiratory and oral cancers

Respiratory cancers consist of cancer of the lung, bronchus, trachea, and larynx. Oral cancers are a heterogeneous group consisting of cancers of the oral cavity, pharynx and nasopharynx, salivary glands, and gums. Respiratory and oral cancers are discussed here together because of the concordance of evidence pointing to associated factors for these cancers.

GBA experienced higher rates of respiratory and oral cancers as compared to NB while HR 5&6 did not. One must posit risk factors in GBA that are not shared by HR 5&6 and the rest of NB.

Of all the provinces, the incidence of lung cancer in NB males is exceeded only by Quebec (95 vs. 97 per 100,000 population). This is not the case for NB females whose lung cancer incidence rate is less than half the NB male rate (46 vs. 95 per 100,000 population) and lower than the Quebec female rate (46 vs. 55 per 100,000 population). The pattern for oral cancer is different, with the NB incidence rate in males exceeded by NS, NL and MB. For females, the rates are similar among all Canadian provinces.[31]

Associated Factors – tobacco and alcohol use

As a group, respiratory and oral cancers are associated with tobacco use, either smoking (lung, larynx, trachea, bronchus), or chewing (gums, lip, tongue). In addition, oral cancers are associated with alcohol consumption. No discussion of respiratory and oral cancer can ignore the impact of tobacco use on population health. Tobacco use is associated unequivocally with death due to respiratory cancer, oral cancer, other internal cancers, respiratory disease, and cardiovascular disease in regions around the world.[32] Premature death due to lung cancer, in particular, takes a special toll from tobacco use.[33]

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[29] Canadian Cancer Statistics, 2004. Canadian Cancer Society (www.cancer.ca)

[30] Verougstraete V, Lison D, Hotz P. Cadmium, lung and prostate cancer: a systematic review of recent epidemiological data. J Toxicol Environ Health B Crit Rev. 2003 May-Jun;6(3):227-55.

[31] Canadian Cancer Statistics, 2004. Canadian Cancer Society (www.cancer.ca)

Associated Factors – occupational exposures

Other factors may include the role of occupational exposures sustained in mining and industry that cannot be categorically excluded as contributing to the respiratory cancer rate. Some COPC (arsenic, cadmium and chromium) may be inhaled in the course of work and could, in specific circumstances, contribute to respiratory cancer rate.

Associated Factors – environmental exposures

The COPC that could potentially be related to these types of cancers are arsenic and cadmium. It should be noted that according to the HHRA, the estimated environmental exposure commitment for arsenic and cadmium are below their respective TRVs. The environmental exposure commitment for arsenic is relatively large, but attributable to primarily background levels, and not to GBA industrial emissions. Arsenic environmental exposure commitments are also primarily oral (ingestion of food stuffs), and not inhaled, which would be the route associated with lung cancer.

Within the limitations of the present study, it is not possible to attribute the GBA's increased incidence of lung cancer, or the higher incidence of oral cancer, to any factor or set of factors such as environmental exposures, tobacco use, or to alcohol use in the case of oral cancer. Of particular importance for next steps will be the determination of past and current tobacco use rates, alcohol consumption, and occupational exposures of GBA residents to find potential associations with the elevations of oral and respiratory cancers among GBA residents. Considerations should also include issues such as changes in tobacco and alcohol use rates over the past 20 to 30 years, and changes in occupational exposure given that there is a latency period of decades for cancer.

7.2.3.3 Stomach cancer

Stomach cancer is second in frequency to lung cancer around the world. In Canada, however, stomach cancer places about 13th overall, with lung, colorectal, breast, prostate, non-Hodgkin's lymphoma, leukemia, pancreas and uterine cancer among those more prevalent.[34] About 800,000 cases of stomach cancer are identified every year worldwide.[35] Canada identified about 2800 stomach cancer cases in 2003 (1800 in men and 1000 in women). Of these, about 50 in males and 25 in females were estimated for NB in 2003.[36]

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[32] Ezzati M, Lopez AD. Regional, disease specific patterns of smoking-attributable mortality in 2000. Tobacco Control. 2004 Dec;13(4):388-95.

[33] Peto R, Lopez AD, Boreham J, Thun M, Heath C Jr. Mortality from tobacco in developed countries: indirect estimation from national vital statistics.Lancet. 1992 May 23;339(8804):1268-78.

[34] Canadian Cancer Statistics, 2004. Canadian Cancer Society (www.cancer.ca)

[35] Plummer M, Franceschi S, Munoz N. Epidemiology of gastric cancer. IARC Sci Publ. 2004;(157):311-26

Stomach cancer incidence has been declining in the last few decades and this pattern has been observed in Canada and in NB. In Canada, the overall decline in stomach cancer has been about -2.3% among males and -2.6% among women.[37] Known associated factors include *Helicobacter pylori* (*H. pylori*) infection, cigarette smoking, diet, being male, and familial genetic abnormalities. The causes for the decline are not known but there are several candidates reported in the literature that may be responsible: improvements in diet, improved food storage and a decline in the prevalence of *Helicobacter pylori* (*H. pylori*) infection.[38]

Associated Factors – *H. pylori infection*

Epidemiological studies have shown that areas with high gastric cancer rates often have a correspondingly high prevalence of *H. pylori* and prospective studies have shown that subjects with serological evidence of *H. pylori* infection were significantly more likely to go on to develop gastric cancer than those who did not.[39] Several investigators have found similar findings in clinical control trials.[40] *Helicobacter pylori* infection is a risk factor for gastric cancer and most epidemiological studies have estimated a relative risk associated with infection in the order of two to four-fold.[41] Control of *H. pylori* infection may also offer great potential for prevention of stomach cancer.[42] *H. pylori* infection may be controlled by improving general sanitary conditions, case finding and direct treatment of infections, or, in the future, immunization.

The prevalence of *H. pylori* infection is estimated at 50% in some countries. No Canadian prevalence rates were published as of 2004.

Associated Factors – Diet

Carcinogens as potential causes for gastric cancer include N-nitroso compounds. Many N-nitroso compounds, which come from nitrites, which in turn come from nitrates in food following bacterial transformation in a low-acid stomach environment, are established cancer causing agents in animals, but their risk for human gastric cancer is still uncertain.

Other risk factors for stomach cancer include salt and salted food intake. Diet high in salt carries a relative risk of up to 6, and a highly significant correlation between 24-

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[36] Canadian Cancer Statistics, 2004. Canadian Cancer Society (www.cancer.ca)

[37] Ibid.

[38] Hunt RH. Will eradication of Helicobacter pylori infection influence the risk of gastric cancer? Am J Med. 2004 Sep 6;117 Suppl 5A:86S-91S.

[39] Shogo Kikuchi Epidemiology of Helicobacter pylori and gastric cancer. Gastric Cancer. 2002;5(1):6-15.

[40] Wong BC, Lam SK, Wong WM, Chen JS, Zheng TT, Feng RE, Lai KC, Hu WH, Yuen ST, Leung SY, Fong DY, Ho J, Ching CK, Chen JS; China Gastric Cancer Study Group. Helicobacter pylori eradication to prevent gastric cancer in a high-risk region of China: a randomized controlled trial. JAMA. 2004 Jan 14;291(2):187-94.

[41] Lam SK. 9th Seah Cheng Siang Memorial Lecture: gastric cancer--where are we now? Ann Acad Med Singapore. 1999 Nov;28(6):881-9.

[42] Shogo Kikuchi Epidemiology of Helicobacter pylori and gastric cancer. Gastric Cancer. 2002;5(1):6-15.

hour urinary salt content and incidence of gastric cancer has been shown in 24 countries.[43]

Dietary modifications remain potentially one of the most important tools for the prevention of stomach cancer. Overall, the observed reduction in stomach cancer risk can reasonably be considered to be the result of a trend related to widespread improvements in socioeconomic conditions. Domestic refrigeration, increased availability of fresh fruits and vegetables, and a reduced use of salt in salted and preserved foods, are considered to be the most relevant factors in explaining the decreasing temporal trend and the geographical patterns of stomach cancer. Fruits and vegetables, green tea, alpha-tocopherol (vitamin E) and other micronutrients such as selenium have been shown to reduce the risk for gastric cancer. A diet consisting of vegetables and fruits, low in salt, together with the avoidance of cigarette smoking has been estimated to be able to prevent some two-thirds to three-quarters of gastric cancer.

Associated Factors – environmental exposures

Arsenic exposure is associated with a number of internal cancers, including stomach cancer. The HHRA presented in Section 3.0 of this report, demonstrated potential exposure from arsenic, with the major part arising from background or baseline sources, not from the contributions of industrial emissions. The exposure commitments did not exceed the Toxicity Reference Values for arsenic in any age group. The impact of industries with respect to the COPC would not be considered an important risk factor in this type of cancer.

The prevalence of risk factors for the Belledune population in the last 30 years may be considered to have been similar to those favouring a higher stomach cancer incidence diet low in fresh fruits and vegetables and rich in salted, preserved foods, etc.) We have no quantitative data on the prevalence of these risk factors, and in particular, the prevalence of *H. pylori* infection. Improvements in socio-economic status with the concomitant improvement in variety of fresh foods in the diet, the lowering of smoking rates, and improvement of medical interventions in diagnosing *H. pylori* infection may promise a decrease in the incidence of stomach cancer in Belledune as has been observed in other areas. However, the prevalence of *H. pylori* infection in Belledune or the potential contribution of infection to Belledune stomach cancer cases is not known.

7.2.3.4 Colorectal cancer

Colorectal cancer ranks as the third most common cancer among men and women. In 2004, it is expected that approximately 510 New Brunswickers will be diagnosed with colorectal cancer. In Canada, there appears to be an east-west gradient with higher rates found in the east and lower rates found in the west. For example, the highest rate for colorectal cancer in 2004 is found in Newfoundland and Labrador and the lowest is found in British Columbia with the age-standardized incidence rate of 80 and 56 per 100,000 population respectively. The in age-standardized incidence rate for New Brunswick in 2004 is 64 per 100,000.

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[43] Hunt RH. Will eradication of Helicobacter pylori infection influence the risk of gastric cancer? Am J Med. 2004 Sep 6;117 Suppl 5A:86S-91S.

Associated Factors – Diet

Known risk factors for colorectal cancer include high dietary fat and meat, and low fibre, fruits and vegetable intake.[44]

Associated Factors – Other factors

Other risk factors include family history, physical inactivity, obesity, history of diabetes, tobacco smoke, and heavy use of alcohol.[45]

Associated Factors – environmental exposures

There is no specific association noted in the literature with any COPC and colorectal cancer.

7.2.3.5 *Kidney cancer*

The kidney is the 6th most common cancer site among men and ranks 11th among women.[46] In 2004, it is expected that New Brunswick will have a total of 135 cases of kidney cancer, of which, 75 cases will be males and 60 females. It is not clear what causes kidney cancer, however, a number of risk factors have been identified.

Associated Factors – cigarette smoking

Cigarette smoke is strong risk factor for kidney cancer for both males and females. The risk can be as high as 2-fold among active cigarette smokers.[47] Cigarette smoking will provide considerable inhalation exposure to cadmium, so that most studies which have suggested a possible role for cadmium in kidney cancer cannot separate the effect of cigarette smoke as a separate risk factor.

Associated Factors – occupational exposures

Increased risk for kidney cancer has also been reported for various occupations with exposures to petroleum products[48]

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[44] Schottenfeld D, Winawer SJ. Cancer of the large intestine. In: Schottenfeld D, Fraumeni JF, eds, Cancer Epidemiology and Prevention, Second Edition. New York: Oxford University Press 1996: 813-40.

[45] American Cancer Society

[46] National Cancer Institute of Canada: Canadian Cancer Statistics 2004, Toronto, Canada 2004.

[47] Kreiger N, Marrett LD, Dodds L, et al. Risk factors for renal cell carcinoma: results of a population-based case-control study. *Cancer Causes & Control* 1993; 4:101-10.

[48] Boffetta B, Dosemeci M, Gridley G et al.. Occupational exposure to diesel engine emissions and risk of cancer in Swedish men and women. *Cancer Causes & Control* 2001; 12:365-74.

Associated Factors – environmental exposures

Ingested cadmium is not associated with kidney cancer, although it is associated with kidney disease. No other COPC has been implicated in the scientific literature with kidney cancer.

7.2.4 Hospital Separations

Hospital separations reflect the most responsible diagnosis each time a person is admitted and discharged from a hospital. These data are captured at the provincial level and then collated and analysed in a national information system (Hospital Medical Records Institute and Canadian Institute for Health Information). Each separation (i.e. discharge) is counted as an independent event, so that separations by one individual in two circumstances will be counted as two events. In order to aggregate events to individuals, a personal identification number or a statistical algorithm must be used to merge events to individuals. The present study did not aggregate separations to individuals, as personal identifiers were not available for the data received by the study team.

Community consultations revealed that there was considerable concern about the high number of cancer hospitalizations from GBA residents. The analysis of these data are thus in response to community concerns. Hospital discharge information is a good reflection of diseases or services such as surgical interventions (i.e. gall bladder removal, hysterectomy) which require single hospitalizations. When considering chronic conditions such as cancer or respiratory diseases such as asthma, which may require multiple admissions for diagnosis and treatment, hospital separations do not reflect as precisely the population rates of disease, but rather the use of hospital services.

In 1999-2000, NB experienced the highest rate of hospital discharges in Canada, except for the Northwest Territories and Nunavut.[49] Average length of stay in hospital is about the same as the overall Canadian rate.[50]

The patterns of elevated rates of hospital discharges were very similar for both GBA and HR 5&6 as compared to NB which itself has a high rate of this measure. The patterns reflect medical practice in particular areas. Hospital admissions may be higher where there are no alternative ways of caring for sick people outside a hospital setting. Possible explanations may include but are not limited to fewer practicing physicians (high case load), fewer out patient facilities or home care, larger distances between residence and hospital (dispersed cachement area), or that the population is actually sicker and requiring more hospital-based health care. The study team did not have data upon which to make a valid inference on these elevated rates.

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[49] CIHI data: www.CIHI.ca

[50] CIHI data: www.CIHI.ca Average Length of Inpatient Hospital Stay (in Days) for Canada (Provinces and Territories), 1995–1996, 2001–2002 and 2002–2003

The mortality statistics for GBA (increased SMR for "all causes", "all cancer" and circulatory system disease) and for HR 5&6 (increased SMR for endocrine and metabolic diseases and "other causes") can together indicate that there is higher need for hospital services. However, without a more detailed analysis of these patterns, an explanation for the higher hospital separation rates across the board for both GBA and HR 5&6 cannot be confirmed.

7.2.5 Applicability of case control studies for the GBA situation

Case control studies examine exposures or risk factors that are more frequent in those with a disease as compared to those who do not have disease. The measure obtained is an odds ratio that is interpreted as an approximation of a relative risk. As with all observational epidemiology, case control studies demonstrate an association, not causation. One observational study rarely provides sufficiently robust evidence to infer causation. If supported by other evidence, they can be powerful tools for instituting interventions in public health. Case control studies are also more useful if single exposure is known to result or have primarily a single effect. An example would be lung cancer and radon gas exposure.

With specific reference to GBA, cancers found with higher frequency (or in fact, any cancer type) in the GBA as compared to HR 5&6 or NB; can be studied with a case-control methodology. This methodology can examine more closely than at the ecologic level the actual characteristics and exposures of the cases as compared to controls. This design comes more closely to focusing on a potential cause but is fraught with problems referable to obtaining reliable information on these potential causes. In the common situation where cases are deceased, exposures and risk factors would have to be obtained by proxy measures, often from surviving spouses and children, who may be unfamiliar with what they are reporting for someone else. This can lead to exposure misclassification and strongly bias the results. The issue of power must also be included as an important challenge in small geographic areas where the actual number of cases may be very low for many cancer types, as it is in GBA.

8.0 Recommendations

In order to further understand the findings from the CHSA, it will be necessary to conduct research on some of the factors associated with the disease patterns characteristic of the GBA. This is of *higher priority* because it will help to better explain the findings for a community with elevated disease patterns. This research should focus on:

- What are the current (and if possible) past smoking rates?
- What is the prevalence of diabetes? Hypertension? Obesity?
- What is the family history of cases of cancer?
- What foodstuffs are/were eaten regularly such as pickled meats, fish and vegetables?
- What are/were the rates of fresh vegetable consumption?

Of *lower priority* would be a study addressing *H. pylori* infection in stomach cancer cases and in the population in the region (HR 5&6).

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